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19 JUNE 1986

China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--50

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NATIONAL POLICY

ELECTRIC POWER OUTPUT PLANS FOR SEVENTH FYP OUTLINED

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 26 Feb 86 p 1

[Article by Liu Bianyang [0491 6239 7122] and Zhang Heping [1728 0149 1627]]

[Text] In a Beijing meeting, electric power department heads reported that to reverse critical electric power shortages, China's annual average electric power generation capacity for large and medium-sized power generation equipment going into operation during the Seventh Five-Year Plan will be about 7 million kW. This is more than double the 3.23 million kW of the Sixth Five-Year Plan.

According to this plan, by 1990, nationwide electric power generation will reach 550 billion kWh, an increase of 142.7 billion kWh, over 1985 and representing an average annual increase of 6.2 percent. Total investment in electric power construction will be 58.6 billion yuan; 34.4 million kW of electric power generating capacity will be put into operation. The scope of power plant construction will be 54.9 million kW.

It is reported that China's electric power construction plan for the next 5 years is as follows:

Active development of thermal power, mainly in Shanxi, Inner Mongolia, Heilongjiang, Henan, Shaanxi, Ningxia, Shandong, Anhui, and Guizhou--all major coal-producing regions. We will build a number of power plants in these mineral-rich areas. In coastal areas, we will build harbor power plants.

Vigorous development of hydropower with continued development of the upper reaches of the Huang He, the tributaries of the middle and upper reaches of the Chang Jiang, and the hydropower resources of the Hongshui He basin by building a group of hydropower stations. The hydropower resources in northeast and east China make them good areas for construction of medium-sized hydropower stations. We will also help localities develop medium and small-sized hydropower stations.

We must concentrate on gradually developing nuclear power, complete the first phase of Zhejiang's Qinshan nuclear power plant project, and carry out preliminary work for the second phase of the project, and continue construction of the Guangdong nuclear power plant.

We should actively develop power networks throughout the northeast, the west, the east, central, and south, progressively completing a 500 kV central network. Also, finish construction of the Gezhouba-to-Shanghai 500 kV direct current transmission project and link up the central China and east China grids. A responsible spokesman for the Ministry of Water Resources and Electric Power emphatically pointed out that during the Seventh Five-Year Plan increases in the output value of agriculture and industry can remain only as high as increases in electric power production. If the pace of production quickens, the demand for electricity for daily living will skyrocket. Then, after the Seventh Five-Year Plan, we will have a power shortage that may not be alleviated and in fact it may even worsen. How to solve our critical power shortage will require in-depth research.

13226/13046
CSO: 4013/97

NATIONAL POLICY

BRIGHT PROSPECTS FOR INVESTMENT IN ENERGY DEVELOPMENT

Hong Kong JINGJI DAOBAO [ECONOMIC REPORTER] in Chinese 10 Mar 86 p 28

[Text] During its Seventh Five-Year Plan (1986-1990), China will energetically develop hydropower resources; electric power will be a major construction item.

Grand Plan for Hydropower Development

The emphasis on China's development of hydropower is on the middle and upper reaches of the Chang Jiang, the upper reaches of the Huang He, and the Hongshui He basin, as well as preparatory development of the hydroelectric resources of the cascades of the Wu Jiang, Yalong Jiang, Dadu He, Jinsha Jiang, and Lancang Jiang.

For many years, the Chinese have eagerly anticipated the present preparatory work on the Sanxia [Three Gorges] hydropower station on the Chang Jiang. This huge engineering project has benefits of flood control, electric power generation, river transportation, etc., and will have an installed capacity of 13,000 megawatts. It will be the world's largest hydroelectric station.

The Three Gorges hydropower station is planned for completion in the 1990's. It is reported that the Three Gorges Plan Science Center building has been completed. A 40-kilometer highway connecting the Gezhouba and Three Gorges dam site is now under construction. It is projected that construction of a 150-meter-high concrete dam will begin in 1986.

Guangxi's Hongshui He is rich in hydropower resources. The Hongshi He can yield 11.1 million kilowatts of electric power. Besides the Lubuge, Tianshengqiao, Yantan, and Dahua hydroelectric stations, which are already under construction, additional stations such as Longtan, Datengxia, and Etan are being considered for development. This is a total of 10.2 million kW of electricity.

Increasing the Electric Power Supply for Coastal Cities

In the next 5 years, China will increase electric power related construction in the coastal port cities; a number of thermal power plants will be built

and total installed capacity will reach 18.75 million kilowatts. This year it is hoped to put into operation a capacity of 3.6 million kilowatts.

Dalian, Nantong, Fuzhou, and Guangzhou will use foreign investment to import advanced equipment and build a batch of thermal power plants. The State Council passed approval for the Huaneng International Electric Power Development Company to set up negotiations with Japan, France, and the Federal Republic of Germany. Importation of electric power items are the main business. Qingdao and Yentai cities will cooperate with central and local entities to build power plants.

Additionally, the development of nuclear power plants in the coastal areas is one of the measures being taken to develop the electric power industry. From the start of the Seventh Five-Year Plan, within 15 years a batch of nuclear power plants will be built in places deficient in power resources like Guangdong, East China, and the Northeast. As of now, the Daya Bay nuclear power plant in Guangdong and the Qinshan nuclear power plant in Zhejiang are already under construction.

As China's major hydroelectric and coal resources are concentrated in the southwest, northwest, and northwest Huabei, while most electric power consumption is concentrated in the southeast coastal region, the Chinese Government has decided to develop long-distance, high-voltage power transmission lines. A few major power lines now under construction or in the planning stage are as follows. Already under construction in Anhui Province is the Huainan-to-Shanghai 500 kV line which can provide Shanghai with 1 million kW of power a year. A 500 kV transmission/transformer project will link Guangxi and Guangzhou provinces and stations on the Hongshui He will make 600 to 700 megawatts of power a year available to Guangzhou.

The state has also decided to exploit the upper reaches of the Huang He, which is rich in hydropower resources, to send power to northern China to support developed coastal cities like Tianjin. In the Chang Jiang river basis, China's largest hydroelectric station, the Gezhouba power station, will construct China's first two phase, 500 kV direct current power transmission line to Changhai. After completion, this line will make 1.2 million kilowatts available to Shanghai. After the construction of these super high voltage power transmission lines, the cities of Zhanjiang, Beihai, Ningbo, Wenzhou, etc., will all benefit.

China-Foreign Cooperation Already on Large Scale

Due to the rapid development of hydropower resources and faster electric power construction, Vice Premier Li Peng has welcomed international investment and cooperation. According to reports, the U.S. Government has announced that it will help China to plan construction of the world's largest hydropower station at the Three Gorges. U.S. specialists are already visiting China and assisting in planning. As a result of bidding both within and outside China, the Taisei Company of Japan was awarded the bid and has already started construction of the Lubuge power station on the Hongshui He. Also, the World

Bank has lent China U.S. 145 million. A special international advisory group including Australia's Snowy Mountain Company and Norwegian experts is also providing consultation. Guangzhou is already building two power facilities in joint ventures with foreign businesses.

With the use of foreign capital and advanced equipment, nuclear power plants can be built. The Chinese Government has already made nuclear power cooperation agreements with Great Britain, the Federal Republic of Germany, and the United States.

13226/6662
CSO: 4013/100

NATIONAL POLICY

MEASURES SOUGHT TO HEAD OFF EXPECTED RURAL ENERGY SHORTAGE

HK200319 Beijing CHINA DAILY in English 20 May p 3

[Report by staff reporter Hu Sigang]

[Text] Rural areas face a severe energy shortage in the 1990s, unless urgent measures to tackle the potential crisis are put into operation.

With the development of local industry and improvement of farmers' living standards, the demand for energy is skyrocketing, according to a senior official of the Ministry of Agriculture, Animal Husbandry and Fishery.

If no effective measures are taken to match supply with demand, rural economic development and the ecological balance could be seriously affected, he warned. "in this situation, two avenues are open to us," he said. "One is to exploit local energy resources and the other is to develop energy-saving techniques."

By 1990, the rural production sector will need energy equivalent to at least 170 million tons of standard coal a year while farmers will need 60 million tons for domestic use. But the state will only be able to provide energy equivalent to 190 million tons of coal, according to the official.

However, China has already mapped out measures to ease the energy shortage.

During the Seventh 5-Year Plan period (1986-1990), 3.25 million kilowatts of electricity will be generated a year by small hydropower stations scattered around the country; 60 million hectares of new forests for fuel will be planted; 70 million more fuel-saving stoves will be distributed and another 2.5 million farm families will use biogas (methane) for cooking, according to the official.

In areas with abundant natural energy resources but little electricity, power stations generating 5,000 kilowatts a year will be installed fuelled by biogas.

Some 250,000 solar stoves will be introduced along with solar heating equipment and 50 more geothermal energy projects will be started. The ministry plans to cooperate with other ministries to further develop wind and wave power and means to save 30 million tons of standard coal a year should be devised by the end of 1990.

"By then, 4 percent of the rural population will use quality gas fuel and 60 percent will use clean and convenient fuel-saving stoves," he said. Great changes would surely take place in the rural energy situation if the goals were all realized, he said.

The official said the outline plan for rural energy development was feasible. "But the task in front of us is an arduous one."

Leaders of all localities and farmers have been urged to increase their efforts to bridge the energy gap by developing new techniques and exploiting new resources.

At the moment, most farmers still consume energy in relatively primitive ways. Waste is high. People mainly burn straw and plant stalks; in 1985, 200 million tons of straw and stalks were burnt. As a result, nitrogen and phosphorus amounting to 60 percent of the country's total fertilizer output was lost. And green coverage has been reduced from 12.7 percent in 1976 to the present 12 percent owing to tree felling for fuel.

The official said that the central government was very concerned with energy development in rural areas. Special offices have been set up in the State Council, the State Economic Commission, the State Planning Commission, the State Science and Technology Commission, and several ministries to supervise the rural energy development.

/12232
CSO: 4010/53

NATIONAL POLICY

BRIEFS

EXPANSION IN SEVENTH FYP--Beijing, 12 May (XINHUA)--China plans to construct power plants with generating capacities of 60 million to 65 million kilowatts during its Seventh Five-Year Plan period (1986-90). Officials of the Ministry of Water Resources and Electric Power told XINHUA today half of an unspecified total number of plants will be completed during the period, and an additional capacity of up to 7 million kilowatts is now expected every year. Already four giant hydroelectric stations--Lubuge, Tianshengqiao, Yantan, and Dahua--are well under way on the Hongshui [He], along with another dozen power facilities, including two nuclear ones. [Text] [Beijing XINHUA in English 1340 GMT 12 May 86] /9604

CSO: 4010/52

POWER NETWORK

SICHUAN TO ADD 2.28 MILLION KW IN CAPACITY IN SEVENTH FYP

OW162105 Beijing XINHUA in English 1917 GMT 16 Apr 86

[Text] Chengdu, 16 Apr (XINHUA)--Sichuan Province plans to build a big power plant and a hydropower station to meet the needs of its fast economic development.

Some 2.28 million kW of power-generation capacity will be added to this most populous province during the 1986-1990 period, according to local officials.

The province is still short of electricity though it has produced an annual 16 billion kWh of electricity over the past few years.

By 1990, the province will be able to annually generate 25 billion kWh of electricity, a 56 percent increase over 1985.

The thermal power plant, to be built in the northern part of the province, has a design generating capacity of 900,000 kW, which involves a total investment of 1 billion yuan.

Two generating units of 335,000 kW each will be imported from France. One of them is expected to go into operation by 1989.

Construction of a hydropower station with a generating capacity of 3 million kW will start next year in the southwestern part of the province. The station, with a total investment of 3.2 billion yuan, is to be completed in 10 years. Upon completion, it will be able to produce 16.5 billion kWh of electricity a year--equal to the present total electric energy production of the province.

The money needed for the construction will both come from the state and be pooled among localities.

/12858
CSO: 4010/47

POWER NETWORK

NORTHWEST TO SEE BIG GROWTH DURING SEVENTH 5-YEAR PLAN

HK210452 Xi'an Shaanxi Provincial Service in Mandarin 0030 GMT 18 Apr 86

/Text/ During the Seventh 5-Year Plan period, China will vigorously develop its northwest electric power industry. It will increase the installed capacity there by more than 200 percent compared to that of the Sixth 5-Year Plan.

During the Seventh 5-Year Plan period, China will move to the west a number of enterprises which consume large amounts of electricity. Therefore, the power consumption of northwest China will annually increase by more than 10 percent. In order to meet this situation, the northwest will make full use of such advantages as coal and water resources to greatly develop the power industry.

During the Seventh 5-Year Plan period, the northwest electric power industry will continue to simultaneously develop hydroelectric and thermal power generation; large, medium-sized, and small power stations; and state-run and local power stations.

In hydroelectric power generation, the Longyangxia and Ankang hydroelectric power stations will be put into operation. Construction will start on the Lujiaxia and (Daxia) hydroelectric stations on the upper reaches of the Huang He.

In thermal power generation, a number of power stations will be built and expanded. Output capacity will be increased by 2.2 million kilowatts.

At the same time, the region will build a number of power transmission projects serving these power stations so as to promptly achieve the goal of linking the power grid in northwest China with that in north China.

/12228
CSO: 4013/110

POWER NETWORK

BIG GEZHOUBA TRANSFORMER READY FOR TRIAL OPERATION

OW281344 Beijing XINHUA in English 1325 GMT 28 Apr 86

[Text] Wuhan, 28 Apr (XINHUA)--A 500,000-volt transformer station, China's biggest, will soon be put into trial operation at the Gezhouba hydroelectric project complex in Hubei Province, XINHUA learned today.

This will pave the way for the transmission of electricity from the Gezhouba complex to central and eastern China. When completed, Gezhouba will have a total generating capacity of 2,715,000 kilowatts.

The first stage of the scheme, with a capacity of 965,000 kilowatts, has generated 25.45 billion kilowatt-hours of electricity since it went on stream at the end of 1981.

This year, two generating units of the second stage, with a combined capacity of 250,000 kilowatts, will go into operation.

/8309
CSO: 4010/51

POWER NETWORK

STRICT CONSUMPTION QUOTAS URGED FOR QINGHAI POWER USERS

HK270830 Xining Qinghai Provincial Service in Mandarin 2230 GMT 23 May 86

[Text] In order to ease the shortage of power in the fourth quarter, the storage season at Longyangxia Reservoir, and to ensure the fulfillment of this year's industrial production tasks, the provincial finance and economic commission held a work meeting between 20 and 22 May on the planned consumption of electricity. The meeting urged the departments in charge of electricity to rationally set up power consumption quotas for consumers. They should not excessively distribute and consume electricity when the power network has shortages. We should take economic measures against those consumers who do not consume power according to the assigned quota and who hide the fact from others. All departments should balance in a comprehensive way their electricity load. At the end of the third quarter, the industrial enterprises should have fulfilled 80 percent of the annual production quota. Enterprises will be given electricity in connection with their economic results.

The meeting also urged the consumers to save electricity. Beginning with technology and management, the enterprises should strive to reduce their amount of power consumption.

/6091
CSO: 4013/130

POWER NETWORK

BRIEFS

NEW ZHEJIANG PROJECTS--As revealed at Zhejiang's power industry work conference on 14 March, three new power-generating units totaling 300 MW will be put into operation in the province this year. Other provincial electric power projects expected to be completed within the year include four power transmission lines of more than 220 kV and five transformer stations. In addition, work is being stepped up to have the Zhoushan direct-current power transmission project completed this year. This project, designed by Chinese engineers and using domestically made equipment, is the first of its kind in China. /Summary/ /Hangzhou Zhejiang Provincial Service in Mandarin 1000 GMT 14 Mar 86 OW/ 12228

CSO: 4013/110

HYDROPOWER

CRITICS, PROPONENTS OF THREE GORGES PROJECT AIR VIEWS

HK260839 Hong Kong PAI HSING in Chinese No 118, 16 Apr 86 pp 28-30

[Article by Jung Chou [2837 3166]: "Heated Debates About the Hydroelectric Power Station Across Chang Jiang's Three Gorges"]

[Excerpts] Debate over the hydroelectric power station project across Chang Jiang's three gorges has been going on since it was first proposed. In a meeting with U.S. Energy Secretary John Herrington on 14 March, Zhao Ziyang said: "The Three Gorges project will be the largest of its kind and it has caught the world's attention. The Chinese Government has done voluminous preparatory work on it, however, some economic and technological problems need to be further explored." Obviously, it is final that the construction of this project undergoing long preparations will get under way. However, this does not mean that debate among different views will be over. That is why Zhao Ziyang said some problems "need to be further explored."

It has been learned that this project was given the go-ahead by the highest CPC authorities back in 1984. When the State Council gave its approval in principle to the "Report on the Feasibility Studies of the Chang Jiang Three Gorges Water Control Project," it was decided that a Three Gorges project construction preparatory headquarters be set up by the Gezhouba Project Bureau, which is known for its abundant building eqiupment and technological and human resources. A number of construction workers were to be sent with the headquarters to settle at the confluence of Letian Brook at Sandouping, 40 km upstream from Gezhouba. On 15 November 1984, Vice Premier Li Peng made a formal announcement to start "preparations for the development of the Chang Jiang Three Gorges Hydropower Station Project, which will have a total capacity of 13 million kW, with each generator set exceeding a capacity of 500,000 kW." This announcement was made at a meeting marking the 50th anniversary of the founding of China's Electrical Engineering Society in the Great Hall of the People. In coordination with the construction of the project. China planned to merge Xanxian and Peiling, Sichuan and some counties and cities in Yichang and Enshi, Hubei into a new province, "Sanxia", and Li Boning, former vice minister of water resources and electric power, was appointed leader of the preparatory group of the new province.

As the Three Gorges Hydroelectric Power Station is a megaproject involving enormous financial, material, and human resources, its success or failure is of great importance. In view of the lessons drawn from the hasty decision on building the Baoshan Iron and Steel Works in Shanghai, a number of luminaries experts, and scholars have put forth many proposals and questions. The CPPCC thus sent an investigation team headed by 90-year-old Sun Yueqi to make an on-site survey of the Three Gorges on the Chang Jiang. Later, a problem-laden survey report was submitted. Since then, relevant debate has spread both at home and abroad. The author has close friends among the famous water conservancy and electric power experts and has learned from them some inside stories concerning the project. Following are some issues of universal concern, to be recorded here for the reference of the reader.

Comprehensive Economic Results

It has been disclosed that the Three Gorges Hydropower Station is a mammoth project that will bring comprehensive economic results in flood prevention, irrigation, power generation, navigation, and aquaculture.

China has for the past 3 decades and more expended a huge amount of financial and human resources on preventing floods and on dealing with emergencies every year, with staggering accumulative figures. If a great flood should recur, it would be dreadful to contemplate a break in the Xing Jiang dykes. Living now in the flood-diversion region is a population of 400,000. Even if the flood-diversion gates were open, the direct losses incurred would be more than 20 billion yuan, which exceeds the budget for the Three Gorges dam in design. Involved experts believe that the building of the Three Gorges project is the only way to relive the threat of floods to millions of people on the banks of the Xing Jiang, as the project will efficiently control 95 percent of the source of floods in this region.

The annual output of the Three Gorges Hydropower Station will be more than 65 billion kW/hr, which would consume more than 35 million tons of raw coal or 18 million tons of oil for ordinary thermal power plants. In addition, it will be pollution-free and free of the heavy demand on transportation of fuel and minerals, as well as dealing with waste and ash. At the same time, it will help correct the shortcomings of the Chang Jiang's imbalanced distribution of power resources along its river valleys and satisfy the energy-starved industrially developed zones in its middle and lower reaches. Moreover, the Three Gorges Reservoir will serve to regulate the water flow, which will help raise the generating capacity of the Gezhouba hydropower station from 760,000 kW to 1.5 million kW. Experts believe that the building of the Three Gorges hydropower station will be one of the decisive factors in the rapid economic development of the mainland.

Tremendous Investment Involved

As reported in a Hong Kong newspaper, the Three Gorges Project involves an estimated investment of 60 billion yuan, which is quite beyond China's means. Some people believe that the project will eat up more than $20 billion

worth of foreign currency and land the nation heavily in debt, when the loss will definitely outweigh the gain. A friend of the author questioned an export of the "Chang Jiang Navigation and Water Conservancy Development Committee" and learned that the total investment in the budgetary estimate for the project would be 16 billion yuan, including $1 billion worth of foreign currency. The whole lot would be spent in 17 years, and the average annual investment would be 1 billion yuan, which is within the means of the nation. Besides, the completed Gezhouba Project will be a leading component of the Three Gorges Water Control Project; it will bring in about 500 million yuan from its output; and when all its 21 generator sets are tied into the power network, its income will more than double. After the Three Gorges Project has been under way 8 years, two generator sets with a capacity of 1 million kW will have been put into production. From then on, four generator sets will be put into production on an annual basis, so the Three Gorges Project will be able to solve its investment on its own.

Some people hold the view that refraining from or putting off the building of the Three Gorges Project and building another 20 large and medium hydropower stations in its stead, will involve less investment but bring about quick results. In fact, only 6 initial designs of these 20 hydropower stations in the proposal have been submitted; the rest are still castles in the air. It is impossible to break ground in the near future. Moreover, efforts can be concentrated when building the Three Gorges Project; with the huge volume of work involved in installing the generator sets, overlapping expenditures in building and waste in human and financial resources may be avoided. The investment to install the generator sets averages 1,200 yuan per 1,000 kW, which is much lower than the average investment on projects in mainland China today. The Three Gorges hydropower station will span the Chang Jiang. The effective utilization time will be 5,200 hours a year or 3,000 hours more than the 20 projects that would replace it. Its output will be more than 30 percent greater than the 20 projects put together. Even the acreage to be covered by water will be 50 percent less and the number of people to be evacuated will be 30 percent less. It is difficult to estimate the normous role of the Three Gorges Project in the economic development in East and Central China after the 1990's.

Discussion on "damage to the ecological balance" has spread since the building of Gezhouba. Some say the dam has raised the water level, submerged a large area of land, and even more seriously increased the alkalinity of a large area of land in the vicinity. Some say the dam has upset the natural habitat of aquatic animals in the river; affected most is the Chinese sturgeon, a "living fossil". Others say the dam has blocked the silt in the river, which may lead to a phenomenon similar to the Aswan Dam in Egypt which has caused seawater to erode the original fertile farmland on the Nile River Delta. Still others worry that Shanghai, situated on the estuary of the Chang Jiang, will gradually be swallowed by the sea. Besides, the dam has blocked organic sediment, which will result in a drastic drop in aquatic products at the Chang Jiang estuary. According to Sun Heian, deputy director of the Gezhouba Project Bureau and chief coordinator

of the Three Gorges Project Preparatory Headquarters, there is some truth to these objections but they are views based on superficial knowledge. Over thousands of years, disastrous floods often took place along the Chang Jiang, and the environment for human subsistence has often been gravely threatened. Today, when we are trying to tame this "mustang" turning the harmful into the useful, why should we be unhappy about it? With the water level raised after the building of the dam, the water conservancy and irrigation of farmland will be markedly improved, and farming and production in the vicinity will inevitably undergo relative changes in development; it is not fair to single out the alkalinity of the soil.

The Gezhouba Dam has sand-washing sluices with a maximum flow at 10,000 cubic meters per second, which is capable of washing away the silt from upstream. Needless to say, a large amount of organic sediment is contained in the silt. The Three Gorges dam will have larger silt-washing sluices, so it is groundless to say the estuary of the Chang Jiang and Shanghai will be threatened.

Some people have asserted that with the building of Gezhouba, the Chinese sturgeon will be doomed to extinction. They wrote the CPC Central Committee and the State Council, demanding protection of the ecological balance of the Chang Jiang. Responsible people of several academic societies published an appeal for "saving the Chinese sturgeon." To deal with this, the CPC designated Du Rensheng, director of the Rural Policy Research Center of the Secretariat to organize a conference on the issue. Wu Xianwen and Ni Shuda, respectively director and deputy director of the Institute of Hydrobiology under the Chinese Academy of Sciences; Cao Wenxuan, research fellow; and Yu Jitang, engineer of the same institute; Ke Xuntao, director of Sichuan Institute of Aquatic Products; and professor Yang Bolu, dean of the Aquatic Products Department, Central China Agricultural College, share the view that the Chinese sturgeon will not be threatened by extinction and that it has the ability to adapt to a new environment.

The Siltation Problem

Whether the Three Gorges Project will lead to siltation is still another focus of discussion and target of attack. Some people believe that the project will bring about siltation, which will eventually turn Chongqing into a dead port. Tang Richang, senior engineer and deputy director of the Siltation Specialty Committee under the Water Conservancy Academic Society has been deputy chief engineer of the Chang Jiang Water Conservancy and Hydroelectric Power Institute for years. According to him, Chang Jiang differs greatly from Huang He. It has better vegetation of grass and trees on its upper reaches than the Huang He, and it is free of loess plateau effects. As a result, its water contains comparatively little silt. Based on the record of Yichang Hydrologic Station, every cubic meter of the water there contains a little more than 1 kg of silt on average -- 10.5 kg when the water is most turbid -- which is, on an average annual basis, only one-thirtieth of the amount of silt contained in the water of the Huang He at the Xiaxian Hydrologic Station. The Chang Jiang has a huge volume of water and a rapid flow, which is 2,770 cubic meters at Yichang during the dry season,

the same as the Huang He when its water is high. The silt in the Chang Jiang falls into two categories: pebble of bed load, and fine sand of suspended particles, according to record, the annual amount of pebble reaching Fengjie County at the upper mouth of the Three Gorges is 700,000 tons -- not much -- and it sinks to the river bed, moving at a very slow rate. When the Three Gorges reservoir is built, the water level will be raised more than 100 meters; it is unlikely that the pebble of bed load will get into the dam area. The amount of sand of suspended load reaching Yichang is 520 million tons. The fine sand is mixed with the water, and will settle only in still water. The water in the approach channel of the Gezhouba is still, creating a sediment problem. But sand washing sluices are built along the channel, which turn the still water into rapids and will basically wash the sand away. The silt close to the fringe of the channel can be removed by dredger.

According to Tang, the real threat will be the backwater area at the tail of the Three Gorges reservoir. Calculating on the basis of the present plan, the dam has a normal water retaining level of 150 meters; the reservoir has its tail in Changshou County, miles east of Chongqing. But the water level will be regulated and changed according to the needs of power generation, flood prevention, and water storage. Here, the rapid water in the river will be decelerated suddenly and form backwater, which in turn will cause siltation. And that is where the idea that Chongqing will become a "dead port" comes in.

To cope with this problem, relevant departments have sent large numbers of scientists and engineers to particpate in research, using electronic computers for calculation, and silt-washing experiments with large-scale physical models in Beijing, Tianjin, Wuchang, and Hankou. Results show that the silt formed in the backwater areas during the high water season can be carried away by the river after floods. But should a windy and sandy season directly follow a dry season, siltation will occur between Changshou and Zhongxian, where shoals are many, and the water has a depth of only 3 meters, obstructing the passage of large vessels. However, based on simulation studies, it will not involve too much work to dredge the silt in this section. Local dredging facilities can remove the silt formed in the backwater areas.

In fact, both the Chongqing city government and the Chang Jiang Navigation Bureau hope the Three Gorges Project will get under way as quickly as possible. Moreover, they hope that the water level of the dam will be raised from 150 to 180 meters above sea level, so that power output can be increased by a large margin and ships with a tonnage of 10,000 can reach Chongqing throughout the year.

The Service Life of the Dam

The Three Gorges dam will be 175 meters in height, equal to the Lonyangxia dam built earlier on the upper reaches of the Huang He, but lower than the Grande Dixence dam in Switzerland, which stands 285 meters high, and the

Rogun dam of the Soviet Union, which is 325 meters in height. Even so, some people still express doubt concerning the service life and the building technology of the Three Gorges dam, and worry about a possible earthquake in this region that would threaten the safety of the dam.

The PRC's Ministry of Geology and Mineral Resources was entrusted to convene a "Symposium on Geological Problems Concerning the Chang Jiang Three Gorges Project for experts and scholars in the summer of 1985. A comprehensive study was conducted on data derived from surface surveys, remote sensing, deep drilling detection, physical and chemical detection, topographic analyses, crystal stress tests, on-site experiments, and seismic monitoring. Finally, a team of experts was formed, consisting of more than 10 professors, research fellows, and senior engineers, which submitted the "Demonstration Report of the Symposium on Geological Issues of the Chang Jiang Three Gorges Project," affirming that "the dam's site at Sandouba is a sound one, suitable to building a dam with a water level between 150 and 180 meters." The report also gives concluding remarks on the studies of such important issues as the stability of the dam area, the possibility of an earthquake induced by the construction of the reservoir, the stability of the dyke along the reservoir, and the submergence and development of the mineral resources in the reservoir area.

A U.S. observation team recently made an on-site investigation in the Three Gorges area and would not buy the idea that Chinese experts think it all right -- barring a major earthquake in the area in the next century. They think it reliable to exclude the possibility of a major earthquake in the next 1,000 and 10,000 years. The rapid progress in modern science and technology will solve a greater number of more complicated problems in the future. Perhaps the Three Gorges Project is linked with China's economic reform and the future of its "well-to-do" living standard; therefore, they must be meticulous as well as resolute, attaching attention to both, which is an important issue testing the CPC authorities.

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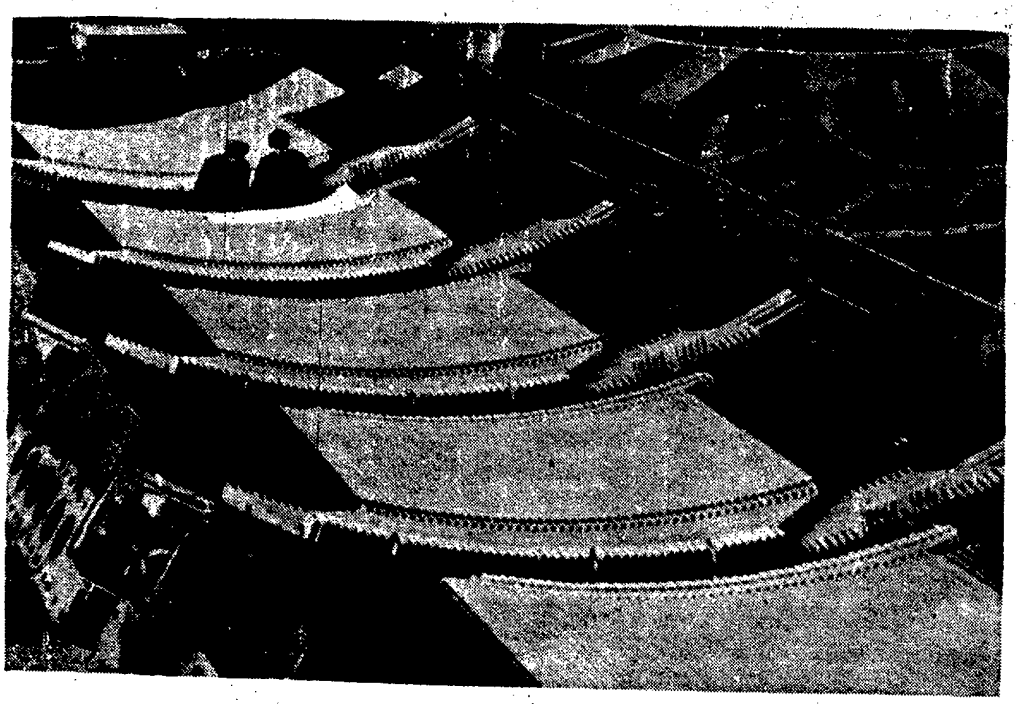
CSO: 4013/121

HYDROPOWER

SICHUAN PREPARES 320MW GENERATOR FOR LONGYANGXIA

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 17 Apr 86 p 4

[Photograph and caption]



In order to meet the need for large-scale power plants, the Dongfang Electrical Machinery Factory in Sichuan has fabricated a single-unit 320,000kW hydraulic turbine generator. This set is currently the largest of its kind to be made in China, and demonstrates that we have reached a new stage in designing and building heavy power generating equipment. The photograph shows the stator for the big hydraulic turbine destined for the Longyangxia hydropower station.

/12232
CSO: 4013/112

HYDROPOWER

WORK ON HUGE MANWAN POWER STATION NOW FORMALLY UNDER WAY

Beijing RENMIN RIBAO (OVERSEAS EDITION in Chinese 2 May 86 p 1

[Text] Kunming, 1 May, (XINHUA SHE)--Construction of the Manwan hydroelectric power station officially got under way today. The station, located on the middle reaches of the Lancang Jiang in Yunnan Province, will have a total installed capacity of 1,500 megawatts.

The Manwan hydropower station will have six 250,000-kilowatt generators, the first of which will be producing electricity by the end of 1991. When completed, Manwan will be the biggest hydropower station in southwest China.

Yunnan Province has rich hydropower resources. Its six major river systems could support over 71 million kilowatts in installed capacity, putting it in second place nationally. The Lancang Jiang, upon which the Manwan station is located, is a major target for development in Yunnan Province. In initial surveys, the Kunming Survey and Planning Institute of the Ministry of Water Resources and Electric Power [determined that] on the more than 1,200 kilometers of the Lancang Jiang that flows through Yunnan, 15 cascade power stations could be built with a total installed capacity of 20.73 million kilowatts. The Manwan hydropower station will be the first station in this 15-cascade plan.

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CSO: 4013/119

HYDROPOWER

LOW WATER LEVELS EXACERBATE GUANGDONG'S POWER SHORTAGE

HK170308 Guangzhou Guangdong Provincial Service in Mandarin 0400 GMT 16 Apr 86

[Text] The provincial economic commission, planning commission, and electric power bureau yesterday afternoon held a report meeting on the situation in electric power to analyze the situation in power supply in our province and to put forward a countermeasure to improve the shortage. At the same time, the meeting emphatically pointed out: The situation in the power shortage in our province can hardly be basically improved in a short period of time. We must really enforce the State Council's provisional regulations on economizing on and controlling energy resources and do a good job in using power in a planned and economical way. Guangdong is one of the provinces in the whole country which are seriously short of power. In the first quarter of this year, due to the fact that the water level of the reservoirs dropped to the lowest level since 1975, hydroelectric power generation was affected. Although power departments tried in every possible way to increase output of thermal power and, at the same time, tried to purchase power from outside the province to increase the total power supplied in the first quarter by about 10 percent over the same period last year, supply still fell short of demand and the shortage of power was very marked. To improve the current situation in the short supply of power, departments concerned will take a series of measures:

1. Since output of hydroelectric power is now reduced, it is necessary to fully tap potentials to increase output of thermal power.

2. It is essential to rationally make arrangements for hydroelectric generating and to increase its utilization rate.

3. It is imperative to put into operation as soon as possible all generating sets imported to all places throughout the province last year. Moreover, the province should buy 500 million kilowatt-hours from Guangxi this year.

4. Watt-hour meters must be installed and electricity-consuming hours staggered. Economic levers must be used to encourage more enterprises to use power in the second half of a month so as to ensure a balance of generating electricity and the supply and use of electricity.

/12929
CSO: 4013/108

HYDROPOWER

WU JIANG: RIVER RICH HYDROPOWER RESOURCE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 12, 12 Dec 85, pp 5-7

[Article by Luo Xibei [5012 6007 0554], Zhao Yukun [6392 3022 2492], and Chen Zuan [7115 4371 1344]]

[Text] The Wu Jiang is the largest tributary on the right bank of the upper reaches of the Chang Jiang and stretches across Yunnan, Guizhou, Sichuan, and Hubei Provinces. The main stream flows through the Guizhou hinterland and merges with the Fuling in Sichuan Province at their confluence with the Chang Jiang. The river covers an area of 88,000 square kilometers which has great hydropower potential. Ranking seventh among the tributaries of the Chang Jiang in terms of area and third in terms of developable hydropower resources, it is one of China's biggest hydropower sources. Moreover, there are many conditions that favor hydropower development on the Wu Jiang, and acceleration of the pace of development is correspondingly important for energy resource planning and construction in China.

1. A River Rich in Hydropower Resources and With Favorable Natural Conditions

The climate along the Wu Jiang is warm with plentiful rainfall (900 - 1,400 mm annually), and the yearly discharge of 52 billion cubic meters is comparable to that of the Huang He. With an average annual depth of 600 mm, the Wu Jiang is also quite deep for tributaries on the upper reaches of the Chang Jiang. Its river valley is deep and drops steeply--according to statistics on the tri-river confluence, the mainstream is 1,037 kilometers long and has a drop of 2,100 meters, indicating a rich hydropower potential. According to data from the National Hydropower Resource Survey carried out in 1978-1980, the theoretical maximum power capacity of the entire Wu Jiang region is 10.426 million kilowatts (91.33 billion kWh per year), to which the mainstream contributes 56 percent (5.80 million kilowatts or 50.8 billion kWh per year). Preliminary development plans now call for a river project to consist of the following nine cascades: The Hongjiadu hydropower station on the Liuchong He "Spigot" cascade, followed by Dongfeng, Suofengying, Wujiangdu, Goupitan, Silin, Shatuo, Pengshui, and Wulong (or Daxikou). The large water head (nearly 1 kilometer) can be exploited to give an installed capacity of approximately 8 million kilowatts with a yearly output of nearly 40 billion kWh (Table 1 shows the results of preliminary calculations of the principal power-generation characteristics for each of the hydropower stations in the various stages: Of the large rivers flowing into the Chang Jiang with developable hydropower resources, the Wu Jiang is surpassed only by the Min Jiang's Dadu He and the Yalong He, which rank first and second.

Table 1. Characteristics of the Hydropower Stations on the Wu Jiang

Name of Station	Hongjiadu	Dongfeng	Suofengying	Wujiangdu	Goupitan	Silin	Shatuo	Pengshui	Daxikou	Total
Flow area (km^2)	9900	18161	21862	27790	43250	48558	54508	69920	86000	
Average yearly discharge (m^3/sec)	147	345	427	511	737	864	972	1320		
Water height at dam site (m)	978	834.7	758	624.4	437	364	292	211	150	
Planned water storage height (m)	1120	970	835	760	630	445	360	293	210	
Dead water height (m)	1070	936	813	720	570	430	340	278	205	
Total dam capacity below normal water storage height (100 million m^3)	30.97	8.64	1.57	21.4	56.9	13.8	6.2	13.8	8.47	161.75
Regulating reservoir capacity (10^8 m^3)	20.97	4.9	0.85	13.5	36.6	5.1	3.8	5.62	1.55	92.89
Regulatory capability	(a)	(b)	(c)	(a)	(a)	(b)	(b)	(b)	(c)	
Useful head (m)	142	135	75	130	185	81	68	82	60	958
Installed capacity (10 MW)	36	51	32	84	200	76	80	120	120	799
Guaranteed generating power (10MW)	13.2	22.2	14.1	36.84	73.76	28.7	31.8	42.4	32.8	295.8
Yearly output (10^8kWh)	13.36	30.0	19.38	46.72	87.7	38.4	39.5	66.11	58.8	399.97
Number of displaced people	12750	8018	52	10633	4540	8746	10100	17030	10660	82529
Arable land flooded	10170	8450	250	20930	7443	10134	7000	10141	8070	82588
Maximum dam height (m)	157	168	111	165	236	112	88.5	119		

Key: a) Year-round; b) Seasonal; c) Daily.

Notes: (1) Although the energy figures listed are related to the discharges, the regulatory effects of the Hongjiadu, which supplements the discharges at the other downstream stations, have been omitted; if included, the total guaranteed power would be much higher. (2) The flooding figures for Hongjiadu and Goupitan are currently under review. (3) The normal water storage height at Hongjiadu may be increased to 1,140 - 1,150 meters in order to enhance the regulation at the stations downstream.

2. Conditions Are Favorable for Reservoir Regulation With Little Flooding Losses

Regulated reservoirs are needed for the rational exploitation of hydropower resources and should be allowed for in development plans.

The results of numerous surveys and research carried out over a period of years went into the formulation of the preliminary draft for the nine-cascade river project; these results address the problem of building reservoirs of adequate size on as little arable land as possible so that as few people as possible are displaced. The advantage of this plan is that it calls for constructing a power station (the Hongjiadu) with a year-round regulable reservoir on the Beiyuan Liuchong He; a dam 140-160 meters high should suffice to form a reservoir with a capacity of 3.1 - 4.45 billion cubic meters which can be used to supplement and regulate the water supply of the downstream cascades. In this manner, excess water can be stored and released by the dam for use during the dry season, so that the power-generating stations downstream will be supplied with an adequate flow of water. In addition, a reservoir of capacity 5.69 billion cubic meters is planned for Goupitan on the middle reaches of the river, and it can also be used for regulation. Except for the Suofengying and Wulong (or Daxikou) cascades, which have only small reservoirs, all the other cascades are to have reservoirs large enough to regulate the flow through the respective stations. The total reservoir capacity of the nine hydropower cascades is to be 16-17.5 billion cubic meters, which amounts to 31-34 percent of the annual flow; this percentage is the same as for the stages used on the Hongshui He and should therefore permit effective regulation. Moreover, in its upper and middle reaches the main stream of the Wu Jiang flows through sparsely populated areas where there is little cultivation; furthermore, although the lower reaches pass near several large cities and towns (such as Sinan, Yanhe, Pengshui, etc.), the plans are designed to avoid flooding these heavily populated and cultivated areas. Preliminary surveys indicate that the nine cascades will flood only 80,000 mu and displace 80,000 people (even if one allows for underestimates of flooding in previous surveys of the Hongjiadu and Goupitan hydropower stations, the estimates for the flooded area and displaced population remain below 100,000 mu and 100,000 people respectively). Compared with the benefits of having a hydropower base with a total installed capacity of 8 million kilowatts, this is a relatively small price to pay--100 mu of flooded land and 100 displaced people for every 10 megawatts. These losses are far less than the 2,300 mu and 1,500 displaced people per 10 MW for existing stations and the 390 mu and 430 displaced people per 10 MW for stations now under construction; moreover, they are even lower than the values for the upper reaches of the Hongshui He and Huang He, which are well known as rich sources of hydropower (see Table 2). The plans calling for multiple hydroelectric stations on the mainstream of the Wu Jiang thus represent a breakthrough in that they provide for regulatory reservoirs while minimizing flooding losses.

3. Scale and Geographic Location of the Stations Are Suitable

The region through which the Wu Jiang flows is rich in minerals and contains a large fraction of the coal, aluminum, phosphorous, mercury, lead and zinc found in China, and the construction of a heavy industrial base now underway

is greatly increasing the demand for power. The river region proper is bounded to the north by eastern Sichuan and to the east by western Hunan, both of which have a critical need for electric power.

The mainstream of the Wu Jiang is situated quite close to the major power-using centers--the sites of the hydropower stations planned for the upper and middle reaches of the Wu Jiang lie just 50 - 130 kilometers from Guiyang and Zunyi (measured linearly); their distance from Chongqing ranges from 160 to 300 kilometers. The stations on the lower reaches are approximately 500 kilometers from Changsha, which again lies within the range for effective power delivery. With the construction of the hydroelectric stages on the mainstream of the Wu Jiang, China will have a hydroelectric power base for supplying Guizhou, Sichuan, and Hunan Provinces.

The installed capacities of the stations (generally between 500 and 2,000 megawatts) suffice to meet the growth in power demand and are realistic given China's present capabilities.

4. Preliminary Work Has Already Been Done and the Plans Are Geologically Feasible

Since the Revolution in 1949, the various departments in China concerned with surveying and planning have earnestly and repeatedly studied plans for developing the mainstream of the Wu Jiang, and a great deal of groundwork has already been completed. Preliminary statistics indicate that up to the present time, 140,000 meters of holes have been drilled and 12,600 meters of tunnels bored at 12 of the dam sites previously studied; this is in addition to a great deal of activity in compiling all types of scale maps showing the geological features of the area. The surveys and experimental work have added to our knowledge regarding the engineering, geological, and hydrological conditions on the Wu Jiang. The mainstream of the Wu Jiang is deep and the strata beneath the river bed are thin; for the most part, seepage is confined to small areas in the reservoir regions, and all of the dam sites have water-impermeable strata that ensure reliable water retention. The bases of the dams will rest on a thick layer of limestone suitable for supporting tall dams. Earthquakes are seldom severe (their intensity is at scale 6 or below); moreover, although natural construction materials are lacking, artificial aggregate materials are in plentiful supply. The foregoing discussion shows that the preliminary development plans are geologically sound. In the past, proposals to construct dams on the Wu Jiang were met with skepticism because of the numerous karsts present in the region. Now, however, with the Wujiangdu hydropower station already successfully completed and construction of the Dongfeng station formally under way, we have gained valuable experience in dam construction in karst regions, and it has become clear that if the surveying and planning work is carried out meticulously, the technical means are available for building dams in karst regions.

5. Less Engineering, Low Cost per Kilowatt

Because of the favorable topography at the dam sites on the Wu Jiang, the size of the construction centers will be relatively small and the cost per kilowatt

will be quite low. The Wujiangdu hydropower station, which was completely finished in 1983, has an installed capacity of 630 megawatts and cost 588 million yuan; the cost per kilowatt (993 yuan) compares favorably with other large hydropower stations which have come on-line in recent years. Budget estimates for the Dongfeng station, with an installed capacity of 510 megawatts, give a cost of 660 million yuan, or a relative cost of 1,290 yuan per kilowatt, which is also quite low compared with the costs at other large and mid-sized hydroelectric stations. In addition, preliminary plans have been proposed for the Pengshui and Goupitan stations to have installed capacities of 1,200 megawatts and 2,000 megawatts, respectively, at a cost of 1.44 billion and 2.18 billion yuan, corresponding to 1,200 yuan and 1,090 yuan per kilowatt, respectively. Again, these values are quite good.

Table 2

River section	Hongshui He	Huang He (from Longyangxia to Qingtongxia)	Wu Jiang
Number of power stations	10	15	9
Installed capacity (10 MW)	1112	1246.4	800
Yearly output (10^8kWh)	603	500.6	400
Farmland flooded (10^4 mu)	16.43	34.11	8.25-10
Persons displaced (10^4)	18.03	18.43	8.25-10
Relative flooded area (mu/10^4 W)	148	273	103-125
Relative displaced population (people/10^4 W)	162	148	103-125
Flooding/energy ratio (mu/10^8 kWh)	272	681	206-250
Displacement/energy ratio (people/10^8 kWh)	299	368	206-250

6. Improved River Navigation

The main stream of the Wu Jiang is full of shoals and rapids and the river channel is narrow, which accounts for its notoriety as a dangerous river for navigation. The 485 kilometers of river channel between Wujiangdu and Longtan contains 355 shoals of various sizes which pose great difficulties to navigation. Dredging operations begun after liberation in 1949 have made it possible for passenger and cargo vessels in the 20-100 tons class to navigate the 450-km-long stretch of river between Dawujiang to Fuling; however, the shallowness and narrowness of the river bed, the sharp bends in the river, and other

difficulties continue to rule out all but seasonal travel upstream from Longtan. As a result, navigation remains restricted in the Guizhou interior and in Sichuan, and boat travel is very inconveneint. With the construction of the multistage hydropower project on the main stream of the Wu Jiang, however, some of the shoals will be flooded and the river bed will be broadened and deepened; at the same time, navigation on the middle and lower reaches of the Wu Jiang will be facilitated by dredging and by the regulatory action of the reservoirs, which supplement the river discharge during dry spells. This will make it possible to link Guizhou Province by water transport to the mainstream of the Chang Jiang.

Conclusions

To summarize, we believe that conditions are exceptionally favorable for the development of the Wu Jiang. A great deal of waterpower is available with minimal flooding losses, the cost/power ratio is low, the geological conditions are favorable at the dam sites, the geographic features are good, and navigation conditions on the Wu Jiang will be improved. Upon completion, the project will turn the Guizhou-Sichuan-Hunan region into a hydroelectric power base. Moreover, the economic growth of this region also requires that the pace of development of the Wu Jiang be quickened. The pr-sent task to compile the various plans and reports into a final document to clarify as quickly as possible the policy and procedural issues involved. If the development of Wu Jiang multistage power project is pursued steadily in the future, there is reason to hope that the river can be transformed into a hydropower base within the next 20-25 years.

12617/12232
CSO: 4013/59

HYDROPOWER

U.S. SAID EAGER TO SUPPORT THREE GORGES PROJECT

Hong Kong TA-KUNG PAO in Chinese 15 Mar 86 p 2

[Text] U.S. Department of Energy Secretary Herrington met with Premier Zhao Zhiyang in Beijing yesterday. Herrington said that on this trip he proposed to China the U.S. willingness to supply technology, equipment, and scientific/technological know-how and to cooperate with China to build the huge Three Gorges hydroelectric plant.

The day before yesterday, Herrington met with China's Minister of Water Resources and Electric Power Qian Zhengying to discuss the Three Gorges project. Yesterday, Zhao Zhiyang told Herrington that China had already begun preparatory work on the Three Gorges hydroelectric project, but there are some economic and technical aspects which have to be advanced for discussion. Zhao Zhiyang added that China wants to cooperate with foreigners for technology, equipment, and acpital for the Three Gorges project.

On this visit, Herrington is seeking advice and also is going to Sichuan to inspect the Three Gorges site, reflecting the firm desire of U.S. firms to try to find a way to participate in the building of this enormous, world-class hydropower station.

The Sino-U.S. nuclear cooperation agreement had a lot of problems until last year, when it was finally signed. Aspects of Chinese development of nuclear power plants and Western Europe moving ahead of the United States were connected to the U.S. Congress's delay in approving the Sino-U.S. nuclear power cooperation agreement. Herrington's visit to China exactly coincides with China's stepped-up preparations to build the Three Gorges hydropower station and both sides hope to cooperate in some fashion on this project.

The State Council recently approved the establishment of a provincial administrative division for Sanxia. The area includes the area east of Wan Xian in Sichuan and west of the town of Yichang in Hubei, a total of 34 towns. The Gezhouba project is already producing electricity. From now on, China will take advantage of this source of electric power to develop the Sanxia key water conservation project with an investment of over 10 billion yuan.

The decision to create the new administrative region would almost certainly signal the beginning of the Three Gorges project. This is one of the world's

largest hydroelectric projects and will satisfy China's hopes regarding energy shortfalls. The Chang Jiang has unlimited hydropower resources. The Chinese have dreamed for decades of a Sanxia hydroelectric station and finally it is becoming a reality.

But to build the world's largest, most modern hydropower station, it will not be easy for China to handle the financial resources, technology, and equipment. China hopes to cooperate with foreigners and this means giving foreign industry mutual benefit. Thus, Chinese-foreign discussions on cooperation will surely be a tortuous process. After Herrington's trip to Beijing and his inspection trip to the Three Gorges in Sichuan, he predicted that those concerned with a China-U.S. project will begin contacts.

It has been reported that the U.S. Department of Commerce is willing to spend U.S.$2 million toward a Three Gorges project feasibility study, demonstrating U.S. interest in cooperating with China on this project. Herrington is the secretary of the Department of Energy. Energy is the major constraint in China's economic development. In the future, China and the United States could have much to do in cooperating on energy on a principle of mutual benefit.

13226/6662
CSO: 4013/100

HYDROPOWER

BIDDING BEGINS ON FUJIAN'S SHUIKOU PROJECT

OW051911 Beijing XINHUA in English 1541 GMT 5 May 86

[Text] Fuzhou, 5 May (XINHUA)--International bidding on the civil engineering work on the Shuikou hydroelectric power station in east China's Fujian Province began today.

More than 30 companies from Brazil, France, Federal Germany, Italy, Japan, Spain, the United States, and China have sent representatives to Fuzhou, capital of Fujian Province, to compete for contracts. Their bids will be opened in 70 days.

The scheme, the biggest in China to be financed by the World Bank, is one of the country's key construction projects for the Seventh Five-Year Plan (1986-1990).

The power station, to be built on the Min Jiang, will have a generating capacity of 1,400,000 kilowatts.

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CSO: 4010/51

HYDROPOWER

HUNAN BEGINS CONSTRUCTION OF 1200MW WUQIANGXI PROJECT

HK090301 Changsha Hunan Provincial Service in Mandarin 2200 GMT 6 May 86

[Text] The construction of Wuqiangxi hydroelectric station -- one of the key projects in the Seventh 5-Year Plan of our country -- started yesterday morning [6 May]. The Wuqiangxi hydroelectric station is situated on the upper reaches of the Yuan Shui on the borders of Taoyuan and Yuanling counties. At present, a road leading to the site has been basically completed and a construction command set up.

Interviewed by a reporter of this station at the worksite, Lu Youmei, Vice Minister of Water Resources and Electric Power, said: The installed capacity of Wuqiangxi hydroelectric power station will be 1.2 million kilowatts and its annual electricity output 5.5 billion kilowatt-hours. In the east region of China, it ranks next to the Gezhouba power station. This power station will be completed in 1994. After its completion, it will not only increase electricity output but also regulate the flow of the Yuan Shui and alleviate the threat of floods in the Dongting Hu region.

/12624
CSO: 4013/121

HYDROPOWER

BRIEFS

TIANSHENGQIAO POWERHOUSE UNDER WAY--Construction recently began on the powerhouse of the Tianshengqiao hydropower station (second cascade) in Guangxi Province--a major state project. Situated as it is on the bank of the river with a 220-meter-high, 30-degree slope, construction will be quite difficult. Six 220,000-kilowatt generators are to be installed in the station (for a total installed capacity of 1.32 million kW), the first of which is scheduled to become operational in 1989. When completed, the station will generate some 8.2 billion kilowatt-hours of electricity a year. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 20 May 86 p 3] /12232

CSO: 4013/127

THERMAL POWER

SHAJIAO-B BEING RUSHED TO COMPLETION

Guangzhou NANFANG RIBAO in Chinese 6 Apr 86 p 2

[Excerpt] On the construction site of the Shajiao-B plant, an army of more than 1,500 Chinese and foreign workers and technicians are working 'round the clock on an accelerated schedule. Most of the foundation work has been completed and the main plant buildings are beginning to take shape. It is projected that the first 350MW generating unit could be a producing power by "7-1" of 1987.

Situated on the Pearl River Estuary at Hu Men, Dongguan, Shajiao-B will have a total installed capacity of 700,000 kilowatts. It is a joint project on the part of the Shenzhen Special Economic Zone Power Development Company and the Hong Kong company of Hopewell Power (China) Ltd. Ground was broken on this plant on 28 September 1984 and construction officially got under way on 1 July 1985. Total investment will be HK $3.2 million and the equipment is imported from Japan. When completed the plant will generate 3.6 billion kilowatt-hours of electricity a year (calculated on 60 percent capacity). This project is a joint effort on the part of the Hong Kong Hopewell Construction Company Ltd., general contractors, five technically capable Chinese construction companies, and the Hong Kong Sliding Form Construction Company. The plant buildings require an area of 400,000 square meters, all of which had to be created from fill. With herculean effort, the construction workers had managed to complete the huge earth and rock moving task by the end of June 1985, creating a landfill of some 1.3 million cubic meters. After this they began pouring the concrete for the main plant buildings and the boiler foundations.

/9869
CSO: 4013/128

THERMAL POWER

BRIEFS

SHALINGZI UPDATE--Work on the Shalingzi power plant, a major state project located in the suburbs of Zhangjiakou, began today [15 April]. This power plant has a design installed capacity of 2,400 megawatts. When completed, it will play an important role in supplying electricity to Beijing and the North China region. [Text] [Shijiazhuang HEBEI RIBAO in Chinese 16 Apr 86 p 1] /8309

800 MW XINJIANG PLANT--Urumqi, 1 May (XINHUA)--Work started today on a thermopower plant with a designed capacity of 800,000 kilowatts in Manas County, Xinjiang Yugur Autonomous Region. The station, which will be the largest in Xinjiang, will supply electricity to Urumqi and the Karamay oil field. It is a key regional project being for the Seventh Five-Year Plan period (1986-1990). [Text] [Beijing XINHUA in English 1608 GMT 1 May 86 OW] /9738

SHAJIAO UPDATE--Work has been stepped up on the "Shajiao-A" thermal power plant in Shandong Province. Today, the first 200,000-kilowatt generator has been installed in the plant, a major construction project for Shandong. The total installed capacity of the Shajiao A plant is 1.2 million kilowatts and the investment in the first stage (600 megawatts) will be 800 million yuan. The plant is scheduled for completion in 1988. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 20 May 86 p 3] /12232

CSO: 4013/127

COAL

COAL MINISTRY RESTRUCTURES ECONOMIC SYSTEM, UPS OUTPUT

OW191425 Beijing XINHUA Domestic Service in Chinese 0701 GMT 14 May 86

[Excerpts] Beijing, 14 May (XINHUA)--While restructuring its economic system and promoting coal output, the Ministry of Coal Industry has persisted in improving the conduct of its party members. The improvement of the party members' conduct has resulted in ensuring reform and enhancing coal production.

The coal industry has scored remarkable achievements in restructuring its economic system in recent years. Some people in certain units, however, took advantage of certain loopholes in reform and behaved improperly, such as by lavishing public money on food and drink, indiscriminately issuing bonuses in cash and in kind, purchasing imported luxury cars, and so forth. The ministry's leading party group maintained that, unless these irregularities were promptly curbed, they would obstruct reform and dampen the masses' production enthusiasm. The ministry's leading party group thus took firm steps to improve party conduct while expediting reform and production, considering all these matters equally important. When the ministry's departmental and bureau directors met in Changchun last July to discuss how to carry out the various reform projects, they were also informed of the several cases of indiscipline and were urged to take clear-cut measures to deter unwarranted issuances of bonuses and subsidies and discourage lavishing money on food and drink.

The Ministry of Coal Industry made it a practice to act firmly and promptly in dealing with whoever took advantage of reform and misbehaved. When the bonus system was reformed, the leading cadres of some enterprises used the opportunity to seek personal gains. In 1984, 158 leading cadres at and above the departmental level of the Yaojie Mining Bureau were given bonuses averaging 2,049 yuan each, or 5.8 times more than the average bonus a staff worker of the bureau got that year; each of the six bureau-level cadres received an average bonus of 3,564 yuan, with the highest bonus being 4,344 yuan. The ministry and Gansu Province, where the mining bureau is located, took decisive steps to deal with this typical case. They reorganized the mining bureau's leading group, dismissed those who deserved to be dismissed, and reprimanded those who should be reprimanded. Those who were issued more bonuses than they deserved were instructed to reimburse the bureau.

Thanks to the improvement of party conduct and the attention given to restructuring the economic system and promoting production, such unhealthy practices as lavishing money on food and drink, issuing unwarranted bonuses in cash or in kind, purchasing imported luxury automobiles, and improperly accepting cash or gifts have been stopped in units of the Ministry of Coal Industry in Beijing. Many people have been commended for having deterred unhealthy practices.

The improvement of party conduct has promoted coal production, and the situation in the coal industry has become increasingly promising. Contrary to the previous practice of needing more people in order to increase output, coal mines whose output is distributed by the state increased their coal output by 11.56 million metric tons last year even though the number of their workers and staff had been reduced by 110,000.

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CSO: 4013/130

COAL

STATE-RUN MINES EXCEED TARGET IN FIRST QUARTER

HK170748 Beijing CHINA DAILY in English 17 Apr 86 p 2

[Report by Staff Reporter Xu Yuanchao]

[Text] China's state-owned mines produced 104 million tons of coal in the first quarter of the year, exceeding their target by 3.5 million tons, the Ministry of Coal Industry announced yesterday.

The first quarter output accounts for 25.13 percent of the 1986 plan. A bigger increase in production may be seen in the second quarter, a ministry official said.

The industry as a whole produced 870 million tons of coal last year, but the plan for this year set output no higher than last year, the official told CHINA DAILY.

Of the year's target, 420 million tons will be produced by state-owned coal mines and 450 million tons by local mines. In the past, production by local mines made up 40 percent of total output.

The small coal mines run by local governments, townships, and individuals are mainly located in Shanxi, Henan, and Hebei provinces. "The small coal mines have developed very fast in recent years, but it is difficult to estimate how much they can increase output this year," the official said.

He attributed the development of small mines to a policy of encouragement by the state which urges local governments to open small mines, while the state provides some funds for roads to the mines.

Output from small mines run by individuals is about 15 million tons, but the working life of small mines is short because of unsafe working conditions and manual production methods.

The state had earmarked 5.3 billion yuan this year for capital construction in the coal industry. The funds will be used to open up a number of modern mines and to upgrade some old ones. About 40 percent of the funds will be used for training, housing, manufacture of mining equipment, and scientific research.

He said the government planned to curtail investment in capital construction in the first 2 years of the current 5-year plan. Some mines with a small annual capacity would be shut down because of a shortage of funds.

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CSO: 4010/48

COAL

STOCKPILES GROW AS TRANSPORTATION BOTTLENECKS CONTINUE

HK210125 Beijing ZHONGGUO XINWEN SHE in Chinese 1448 GMT 20 Apr 86

[Text] Beijing, 20 Apr (ZHONGGUO XINWEN SHE) -- Our correspondent has learned from the Ministry of Coal Industry that as of the end of March state coal mines in China had a total stockpile of 13.33 million tons, over 2.2 million tons more than at the same time last year.

According to our information, the shortage of transport is the main reason for the coal stockpile. Some mining areas can only ship out on a day the coal they produce that day, and can do little about the accumulated stockpiles they have on hand. Long periods of stockpiling have caused phenomena such as spontaneous combustion and run-off.

The biggest stockpiles of coal now are in Shanxi Province, where over 4.64 million tons are stockpiled, mainly at the Datong, Yangquan, Huoxian, and Fenxi mines. Shanxi is followed by the Northeast-Nei Monggol coal industry combine, where over 3 million tons are stockpiled, mostly at Heilongjiang's Xixi, Hegang, and Qitaihe mining areas.

The Chinese railroad departments are currently doing everything possible to improve coal transport capacity. Construction of three main railroads in north, east, and south China for transporting coal from west to east is being stepped up. Tracks are now being laid on the line from Datong to Qinhuangdao, which will mainly transport coal, and the electrification of the Fengtai-Shacheng-Datong, Shijiazhuang-Taiyuan, and Taiyuan-Jiaozuo lines, which ship Shanxi coal out of the province, will be vigorously tackled this year. Double-tracking of the Shuoxian-Datong section of the North Tongpu line, which is being undertaken in association with the development of the Pingshuo coal field, will be completed this year. By 1990, the transport capacity to ship Shanxi coal out of the province will reach 270 million tons, 150 million tons more than last year.

Work has also started on the Xingan tunnel on the Binzhou line and the Ducao tunnel on the Binsui line, both in northeast China, with the aim of improving coal transport capacity in the eastern and northern parts of the region. Double-tracking is also being carried out on those lines section by section. The departments concerned are also dredging the Huang He ship channels in order to develop waterway coal transport.

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CSO: 4013/108

COAL

HENAN LAYS PLANS FOR COMPREHENSIVE USE OF COAL

Zhengzhou HENAN RIBAO in Chinese 3 Mar 86 p 4

[Excerpts] Henan is very rich in coal resources and by developing pit-mouth thermal power, coal is transformed into electricity on the spot. This not only solves the long-term electricity shortage of the province's agricultural and industrial production, but makes it possible to transmit electricity out of the province which is more profitable than shipping out coal. It could relieve the strained railroad situation and reduce coal mine overstock. At the same time, developing comprehensive use of coal could spur new industrial development. Therefore, concentrating on electricity generation and the comprehensive use of the province's vast coal resources should become a major guiding ideology for Henan's economic development strategy. In the past, we were unclear about this and for a long time, we sold coal and bought electricity; electricity produced by coal was flowing in the wrong direction and coal resources were overstocked. This is both wasteful and irrational. For example, the electric power shortage in Henan in 1984 was 2.4 billion kWh and in 185 it was even more. This loss of several billion kWh of electricity even affects electricity usage for urban life. In April 1984, when Comrade Hu Yaobang came to inspect Henan, he pointed out, "The on-site transformation of coal to electricity is most economical. From now on, for the next 10 to 20 years, Henan's annual increase of 600 megawatts will equal one-tenth of the national annual increase in electric power." His words made us think: In energetically developing small thermal power bases, we should concentrate on the comprehensive use of coal. From the reality of the situation of our province, the writer considers that during the Seventh Five-Year Plan, and even during the next 10 to 20 years, we should concentrate manpower, material resources, and financial resources in western Henan, northern Henan (Jiaozuo area), and southern Henan (the Pingdingshan area). Because these three regions have coal and water, they have ready-made thermal electric bases; add to this convenient transportation, and we can start quickly and produce results. For example, in western Henan, power plants could be built at the pit mouths and road junctions, effecting local transformation of coal and water resources. We could not only reduce the pressure of coal transport on the railways in Shaanxi, Shanxi, and Henan, but also satisfy the electrification power need of railroads in these regions. Another aspect is that we can ship less coal and transmit more electricity, not only easing the burden on Shaanxi and Shanxi, but also quenching eastern China's thirst for electricity. In this way, we

can further improve social benefits and comprehensive economic benefits. From the point of view of the province, by concentrating on the comprehensive use of coal, in the near future we can alleviate the contradiction between energy consumption and demand and greatly resolve the serious situation in buying electricity over the long term. Because of power shortages, production capacity cannot be fully utilized, representing an annual loss of nearly 10 billion yuan, a loss which could be recovered through the above measures. Another aspect is the increased benefit from, and reduced waste of, coal resources. (According to calculations, 1 ton of raw coal has a more than 3-yuan profit margin. After dressing, the profit margin increases to 8 yuan. Taking as a basis the direct fuel value, production of coal tar increases the value 10 times; processing into plastics increases the value 90 times; dyes increase the value 370 times, and synthetic fibers increase the value even more.) Work on the preliminary stages of the large-scale thermal electric plant in western Henan has already begun. During the Seventh Five-Year Plan, Henan will finish the main construction at the three large thermal electric power bases at Yaomeng, Jiaozuo, and Shouyangshan, and the new construction at the Hebi power plant. Preliminary plans for the next decade include construction of a host of power plants in the three large thermal power electric bases. At the same time, we can use Shaanxi coal and Huang He water to build the Sanmenxia west power station, Yima coal and Huang He water to build the Yima power station, and Deenfeng coal and Yahekou Reservoir water to build the Yahekou power station. Moreover, we can expand and renovate a number of old electric plants and also develop some small thermal electric plants. By the end of the century, the estimated capacity could be nearly 15 million kilowatts; western Henan's electric power generation alone could satisfy the needs of the whole province.

13226/6662
CSO: 4013/100

COAL

HUAINAN TO BECOME 'ENERGY CITY' OF EASTERN CHINA

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 12 May 86 p 1

[Excerpt] According to a report in JIEFANG RIBAO [LIBERATION DAILY], Huainan City will become the largest 'energy city' in the East China region. In the Sixth Five-Year Plan, the state invested some 3 billion yuan and in the Seventh Five-Year Plan an additional 500 million yuan a year will be spent on developing Huainan coal and electric power.

Huainan's coal resources are enormous, with 14.6 billion tons having been verified; in the last 30 years, Huainan has supplied 260 million tons of coal to the nation. During the Sixth Five-Year Plan, the 3-million-ton-a-year Pan-1 mine became operational and in 1985 Huainan produced some 9.6 million tons of [raw] coal. In the Seventh Five-Year Plan, construction will continue on the mammoth mines of Pan-2, Pan-3, and Xieqiao-3, whose total capacity will be 10 million tons a year. Three coal dressing plants with a capacity of 3 million tons will be built concurrently. Also during the Seventh Five-Year Plan, three very large mines with an annual capacity of approximately 4 million tons will be started. By 1990, Huainan will be producing more than 14 million tons of coal a year.

Making use of its superior coal resources, Huainan is exerting a major effort to develop pit-mouth power plants. Today, Huainan is in the first stage of construction on the two power plants of Luohe and Pingyu, with installed capacities of 600 megawatts and 1,200 megawatts respectively. Luohe already has its first 300MW generator in operation. Before the end of the Seventh Five-Year Plan, Huainan's total installed capacity could reach 2,400MW for an annual power output of 16 billion kilowatt-hours of electricity, representing about 10 percent of the output of the East China Grid.

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CSO: 4013/128

COAL

HUAINAN TO GREATLY INCREASE PRODUCTION

OW120412 Beijing XINHUA in English 0154 GMT 12 May 86

[Text] Beijing, 12 May (XINHUA)--Huainan City, a major coal producer in Anhui Province, will increase its annual output from the current 9.6 million tons to more than 14 million tons in 1990, to become the largest coal producer in east China, today's LIBERATION DAILY reported.

The city, north of the province's capital of Hefei, will develop three more large mines in the next 5 years with an annual production capacity of 4 million tons each, according to the Shanghai-based paper.

The state will invest 3 million yuan in the exploitation of the city's coal and electricity resources during the Seventh Five-Year Plan (1986-90), equal to the investment during the past 5 years.

Taking advantage of its rich coal resources, Huainan will also develop its power [plants]. By 1990 the city is expected to generate 16 billion kWh, which will account for about 10 percent of the total generating capacity of the eastern China area, the paper said.

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CSO: 4010/51

COAL

BRIEFS

SHANDONG DISCOVERY--Huge coal deposits have been found beneath the Weishan, Zhaoyang, Dushan, and Nanyang lakes in southwestern Shandong Province. The Shandong Coal Field Geological Prospecting Company has verified these reserves to be in the neighborhood of 2.5 billion tons. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 May 86 p 3] /12232

LIANG HUAI EXPORTS--Hefei, 28 April, XINHUA SHE--The Liang Huai mining district in Anhui Province exported more than 500,000 tons of coal in 1985, generating some 26 million dollars. On this springboard, exports in the first quarter of 1986 exceeded those of the same period of 1985 by 28 percent. Coal resources in the Liang Huai mining district are enormous, with many varieties of excellent quality. The district is only a little more than 300 kilometers from Lianyungang and can be transported directly from the pit mouth to the docks of this port by truck. The coal has a low ash content and high heat yeild and is purchased by traders in Japan and Southeast Asia. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 30 Apr 86 p 3] /12232

NEW SHAANXI FIND--Beijing, 6 May (XINHUA)--A coal field with over 9 billion tons of reserves has been found in Binxian County in northwest China's Shaanxi Province. [Text] [Beijing XINHUA in English 1432 GMT 6 May 86 OW] /12232

200-BILLION-TON FIELD REPORTED--Xi'an, 7 May, XINHUA SHE--The overall development plan for the Shenfu coal field in northern Shaanxi Province--said to be one of the world's seven major fields--was recently approved in principle by the mining region's overall planning review commission organized by the Ministry of Coal Industry. The Shenfu coal field is a mammoth one verified in the last few years. Within the 20,000-square-kilometer field are reserves approaching 200 billion tons. The field's geological structure is simple and the layers are stable and at shallow depths. The coal is low-ash, low-sulphur, and low-phosphorus coal with high heat output. Experts predict that by the end of the century, the Shenfu coal field will constitute China's biggest coal base for motive-power and export coal. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 9 May 86 p 1] /8309

NEW HEILONGJIANG FIELD REPORTED--Recently, the Northeast-Inner Mongolia Coal Industry Joint Company's geology department discovered a new coal field at Dashiqiao, Jixi City, Heilongjiang Province. Preliminary exploration shows that the field has an area of some 60 square kilometers and the seams are about 10 meters thick. The coal is brown coal and the reserves are approximately 500 million tons. The coal is buried at a depth of 400 meters; geological conditions are excellent, facilitating exploitation. Also, the geology department has found another coal field at Jiudaoling in Yi Xian, Liaoning Province with reserves of 50 million tons. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 15 Mar 86, p 1] /9604

VAST SHAANXI FIELD VERIFIED--A large coal field with an estimated reserve of 9 billion tons has been verified in Binxian County, in central Shaanxi. [Text] [Beijing XINHUA in English 1100 GMT 1 May 86 OW] /9738

XINJIANG STRIP MINE--Urumqi, 13 May (XINHUA)--Construction will start next year on an open-cut coal mine 30 kilometers from this capital of the Xinjiang Uygur Autonomous Region, a regional official announced today. The Tiechanggou mine will have an annual production capacity of 1,500,000 tons upon completion in the next 5 years, the second largest open-cut mine in the region. The biggest is the Sandaoling mine, which went into production in the 1970s. The area around Urumqi has 7 billion tons of verified coal reserves out of the region's total of 18.3 billion tons. [Text] [Beijing XINHUA in English 1352 GMT 13 May 86] /9604

CSO: 4010/52

OIL AND GAS

NEW TECHNOLOGY MAINTAINS FLOW OF HUABEI CRUDE

OW161233 Beijing XINHUA in English 0941 GMT 16 Apr 86

[Text] Shijiazhuang, 16 Apr (XINHUA)--The Huabei oil field has adopted new technology to maintain an annual output of 70 million barrels, as it has over the past 10 years, according to oil field officials.

The third-largest in China, the oil field, which opened in 1976, is of the buried hill formation type, which gives high output at the outset but has a fast depletion rate.

Output was as high as 85 million bbl in 1978, but in 1984 it decreased rapidly and was some 40 percent less than the 1978 figure.

To maintain steady output, the oil field adopted such techniques as pumping emulsifying acid into the wells to dissolve obstructions, and the application of a new chemical agent that controls the movement of water around the wells. Improved water-injection methods have helped restore the natural pressure, oil experts said.

Last year, the oil field pumped out 72.17 million bbl of crude oil, 770,000 bbl more than in the previous year.

Over the past 5 years, more than 218 technological achievements have been made, of which 177 have been applied to production.

The oil field now has some 3,500 technical personnel and is equipped with more than 500 sets of facilities and instruments for scientific research.

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CSO: 4010/47

OIL AND GAS

QINGHAI'S QAIDAM BASIN STEPS UP PROSPECTING EFFORT

OW081445 Beijing XINHUA in English 1349 GMT 8 May 86

[Text] Xining, 8 May (XINHUA)--Chinese geologists have stepped up exploration for oil in the Qaidam Basin in Qinghai Province which promises to be one of the most oil-rich regions in China.

In recent years, Qinghai Province has imported oil exploration equipment from the United States, including seismic survey vehicles, and electronic computers, and cooperated with the Geosource Company, U.S.A. in an extensive search for oil in the basin.

Up to the present, the province has verified geological reserves of up to 200 million tons, including the record find of 19 million tons last year, according to the provincial oil administration.

Geologists used helicopters and advanced instruments and meters to obtain a large amount of petro-geological data in some inaccessible areas.

Qaidam Basin is one of four inland basins in China, with sediment strata covering more than 120,000 square kilometers. It is believed to be one of the most promising oil-rich regions in the country.

To date, geologists have verified 47 oil fields and 5 gas fields with an estimated reserve of 8.9 billion cubic meters in addition to hundreds of oil potential strata and structures.

The province has decided to explore for 400 million tons of geological oil reserves in the next 5 years, according to a plan worked out recently.

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CSO: 4010/52

OIL AND GAS

IMPORTS OF SEISMIC EQUIPMENT FOR OIL EXPLORATION TO CONTINUE

HK111219 Beijing CHINA DAILY in English 11 Apr 86 p 2

[By Staff Reporter Xu Yuanchao]

[Text] China will continue to build up its seismic expertise and import state-of-the-art equipment despite declining income as a result of the current world oil glut.

Cai Peijian, deputy chief engineer of the Petroleum Ministry, told an OPSEIS (Optimum Seismology) users conference in Beijing that although income from crude oil exports has dropped, China will earmark some funds for developing the seismic expertise vital to China's future oil exploration programme.

The users conference, the first of its kind, was sponsored by Applied Automation Inc (AAI), a subsidiary of the Philips Petroleum Company of the United States.

The conference's main purpose is to use combined experience to solve field problems encountered during the first 2 years of operation and to transfer the knowledge of how to use an OPSEIS system.

Lee de Martino, AAI general manager, said at the meeting that his company would be concluding a memorandum of understanding for an OPSEIS service center in Beijing during his visit.

The center, staffed by Chinese personnel, will eventually provide an information network allowing the Oklahoma-based company to pass on new product developments and improved operational techniques to the Chinese.

De Martino said: "The world seismic industry is currently in a dramatic downward cycle. Many companies throughout the world are doing business at below cost and many are going bankrupt.

"We took a hard look at our business as early as 1982 and began to tighten our belts, slashing costs while increasing the efficiency and productivity of our work force. This has helped us remain in a profitable position during these difficult times," he said.

De Martino told CHINA DAILY that China had bought seven complete OPSEIS systems, valued at 13 million. These systems are now used in "mountainous regions, transition zones and shallow water" in six different areas including Nanjing, Sichuan Province, Shengli beach, Renqiu and Dagang oil fields.

/12929
CSO: 4010/46

OIL AND GAS

EXPLORATION CONTINUES DESPITE MARKET CRISIS

OW050550 Beijing XINHUA in English 0531 GMT 5 May 86

[Text] Beijing, 5 May (XINHUA)--Despite the tumbling of world oil prices, foreign firms are continuing with their involvement in the exploration of China's offshore shore oil resources, according to a senior official of the China National Offshore Oil Corporation (CNOOC).

No foreign participants have so far withdrawn from their joint operations with China, said CNOOC deputy general manager You Dehua.

You attributed this to a series of "still more flexible methods" taken by China to attract foreign investment, including exemption of the fees for using oil fields with an annual production capacity of less than 7 million bbl [as received].

Chinese and foreign firms have verified 10 offshore oil and gas fields, he said.

One in the Bohai Sea, north China, has gone into partial operation and another in the Beibu Gulf in the south will start trial production in August. Feasibilities studies are going on for the exploration of the rest of the fields.

In addition, the route for a 1,000-kilometer pipeline from Hainan Island to Shenzhen in south China has been chosen.

/9738
CSO: 4010/50

JPRS-CEA-86-076
19 June 1986

NEW OIL EXPLORATION THEORY APPLIED AT SHENGLI

OW121931 Beijing XINHUA in English 1858 GMT 12 Apr 86

[Text] Jinan, 12 April (XINHUA) -- Testing a new theory about oil exploration, Chinese scientists have discovered oil and gas reserves throughout almost all the levels of the earth at the Shengli oil field, China's second largest.

The theory, which argues that levels of the earth include many elements, led to the discovery of 53 oil pools -- including 32 already in production -- in the Shandong Province oil field, an energy official said here today.

The new theory, which geologists call the "composite oil and gas reserve" theory, was developed by Li Desheng, chief geologist at the Planning and Research Academy of the Ministry of Petroleum Industry in Beijing.

Shengli, at the estuary of the [Huang He] produced 189 million bbls of oil last year, second only to the Daqing field in Heilongjiang Province which produced more than 700 million bbls.

Prospecting began at Shengli in 1964. Early findings encouraged geologists to sink two wells that eventually produced 3,885 and 7,000 bbls of oil per day.

But even though these and other wells were successful, petroleum geologists at Shengli frequently found no oil in spots where conventional theory predicted there would be substantial reserves.

More than a few scientists said traditional research could not accommodate the field's unusually complicated geological formations.

"Sometimes, water gushed out from strata believed to contain oil and gas," Yang Shenbiao, deputy director of Shengli's Geological Research Institute, told XINHUA today.

According to Yang, Li's new theory was welcomed by the geologists at Shengli. And under its guidance, high-yielding wells were sunk in places once believed to have no oil, he said.

Li's theory, which Yang said is not easily summarized, covers possible interrelations between adjacent levels of the earth.

This means, Yang said, "that there might be pools of oil right next to places where there is only water."

In line with the theory, geologists have come to believe the eastern part of the oil field -- a 12,000 square kilometer area known technically as the Jiyang Depression -- is rich in oil and gas, said Yang.

In that depression, according to the theory, there should be pools of oil at depths ranging from 600 to 6,000 meters.

Preliminary prospecting has confirmed projections based on the theory, Yang said. "And as a result, Japanese and U.S. geologists are beginning to take it seriously."

/12929
CSO: 4010/46

OIL AND GAS

NATURAL GAS DEPOSITS DISCOVERED IN HENAN

OW171815 Beijing XINHUA in English 1815 GMT 17 Apr 86

[Text] Zhengzhou, 17 Apr (XINHUA)--Chinese geologists have discovered two coal gas-bearing structures in the Zhongyuan (central China plain) oil field, according to Henan Province petroleum authorities.

A test well completed recently shows that the gas-bearing layer is 120 meters thick.

As one kind of natural gas, coal gas is a new topic in China's geological exploration and study, the petroleum authorities said.

Zhang Wenyou, a noted geologist of the Chinese Academy of Sciences, decided to help the local petroleum administration study coal gas in 1983 when he visited the oil field. Zhang's decision was backed by the State Economic Commission.

After 3 years' intensive study, geologists of the oil field and other research institutes have prepared a report on the coal gas deposits.

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CSO: 4010/49

OIL AND GAS

TWO SINO-U.S. JOINT VENTURES ESTABLISHED

OW160009 Beijing XINHUA in English 2127 GMT 15 Apr 86

[Text] Beijing, 15 Apr (XINHUA)--Sino-Fluor Engineers, a Chinese-U.S. joint venture which was set up here today, signed a contract for building a hydrocarbon tank [farm] for China's Daqing oil field.

Organized by the China Petrochemical International Company (SINOPEC International) and Fluor Engineers, Inc. of the United States, the new company will provide production facilities, pipelines, terminals, hydrocarbon processing, petrochemicals, synthetic fuels, power generation, and industrial and infrastructure services worldwide.

Three days earlier, another joint venture--the Hua-Lu Engineering Co. Ltd.--was established by SINOPEC International and the American Lummus-Crest Inc. It is mainly engaged in petroleum refining, petrochemical, natural gas, and power industries, offering project feasibility study, engineering design and a wide range of technical services.

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CSO: 4010/49

OIL AND GAS

U.S., JAPANESE CONSORTIUM HITS OIL IN PEARL RIVER BASIN

OW211916 Beijing XINHUA in English 1630 GMT 21 Apr 86

[Text] Guangzhou, 21 Apr (XINHUA) -- A foreign oil consortium has hit oil in an exploratory well in the Pearl River Mouth, which is pumping out 1,680 barrels a day, it was announced here today.

An official of the Nanhai (South China Sea) Eastern Petroleum Corporation said the well, sunk by the Pearl River Oil Operating Company, was the 10th oil-producing well to be drilled in the eastern part of the 147,000-square-kilometer Pearl River estuary.

The corporation is responsible for 103,000 square kilometers of the basin which is open to foreign bids.

The Pearl River Oil Operating Company comprises three firms from the United States and two from Japan.

Chen Sizhong, chief geologist of the Chinese corporation, said the new well was 240 kilometers southeast of this Guangdong provincial capital.

He said: "It is only 1 kilometer from the "Zhu-5 exploratory well, which produces about 1,400 barrels a day, and which was drilled by the Chinese Ministry of Geology and Mineral Resources 7 years ago.

"I think the two wells belong to the same oil-bearing structure, where we are likely to make new oil and natural gas discoveries."

He added that there were good prospects for oil and gas exploration in the eastern part of the basin.

Four of the seven exploratory wells drilled since the beginning of the year had hit oil, and four new oil-bearing structures had been found.

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CSO: 4010/48

OIL AND GAS

MORE PRODUCING WELLS DRILLED IN PEARL RIVER ESTUARY

HK230846 Beijing ZHONGGUO XINWEN SHE in Chinese 1447 GMT 21 Apr 86

[Report: "Twelve Oil-Yielding Wells Drilled in Basin Near Zhu Jiang Estuary" --ZHONGGUO XINWEN SHE headline]

[Text] Beijing, 21 April (ZHONGGUO XINWEN SHE)--China National Offshore Oil Corporation today announced that oil and gas had been found in the Xi Jiang 34-3-1 well recently drilled in the Zhu Jiang Estuary Basin of the South China Sea. Testing has shown that this well can produce 267 tons of crude oil a day as well as a small amount of natural gas.

So far, 12 oil-yielding wells have been drilled in the Zhu Jiang Estuary Basin.

The Xi Jiang 34-3-1 well is located in the 15/33 contract zone in the Zhu Jiang Estuary. This contract zone has an area of 1,279 square kilometers. The contractor is The Pearl River Oil Operating Company, founded by five foreign companies.

The Xi Jiang 3403-1 well is 240 kilometers to the southeast of Guangzhou. Just 1 kilometer to the north of this well, the Chinese Ministry of Geology and Mineral Resources in 1979 drilled a test well--the Zhu-5 well, with a daily output of 200 tons of oil. The geological conditions of this zone have yet to be further evaluated.

/12232
CSO: 4013/114

OIL AND GAS

LARGE OIL DEPOSIT FOUND IN WESTERN QINGHAI

HK010427 Xining Qinghai Provincial Service in Mandarin 2330 GMT 30 Apr 86

[Text] The Qinghai Petroleum Administrative Bureau has discovered an extremely large oil deposit in the (Nayishan) area in the western part of the Qaidam Basin. The Ministry of Petroleum Industry recently decided to list the area as a pilot project area in scientific oil prospecting work this year.

The structure covers an area of 620 square kilometers. In mid-June 1985 the Qinghai Petroleum Administrative Bureau drilled to a depth of 2,981 meters there, at which point a large flow of oil and natural gas started. The flow has continued up to now, showing that there are abundant oil layers with a strong flow.

The provincial Petroleum Administration Bureau is treating the structure as a key drilling area. Three drilling teams and two oil-testing teams are now at work there.

/12232
CSO: 4013/114

OIL AND GAS

PETROLEUM, GEOLOGY MINISTERS EXCHANGE VIEWS ON COOPERATION

OW280150 Beijing XINHUA Domestic Service in Chinese 0809 GMT 27 Apr 86

[Article by reporter Wang Yangrong]

[Excerpts] Beijing, 27 April (XINHUA)--Minister of Petroleum Industry Wang Tao and Minister of Geology and Mineral Resources Zhu Xun extensively exchanged their opinions recently on how to further strengthen cooperation between the two ministries in prospecting for oil and natural gas resources. Their cooperation was highly praised by Comrade Wan Li who said that it was a good beginning in eliminating barriers between different departments and strengthening lateral ties among various ministries.

The two ministers noted that great achievements have been made in developing petroleum production and geological work since the founding of the People's republic of China. They pointed out that those achievements were due to joint struggle by the workers of departments of the of the two ministries. In order to realize the goals set for 1990 and 2000 in petroleum and natural gas production, it is imperative to discover adequate petroleum and natural gas resources as quickly as possible. This is a very arduous task and it requires concerted efforts by both ministries' geological teams. We should have a unified plan and proceed under the principle of division of labor with good coordination. In addition, various teams should exchange data from their respective work areas to avoid unnecessary overlapping work and should fully develop the overall economic benefits of prospecting funds. Accordingly, the two ministries will jointly study the division of work in prospecting for petroleum and natural gas in 1986 and during the "Seventh 5-Year Plan."

The two ministers are convinced that merely depending on the budget set for prospecting work will be far from adequate in meeting the demand for funds. Wang Tao suggested that the method of compensatory transfer can be used in order to enable the petroleum and geological teams to have more funds for prospecting work and strengthen the vitality of various petroleum and geological prospecting units. Comrade Zhu Xun completely agreed to the suggestion because it is in line with the spirit of reform and in accord with the principle of the "Mineral Resources Law."

The two ministers also exchanged their opinions on cooperation in opening to the outside world and principles for handling some specific matters and reached a consensus.

/12232
CSO: 4013/114

OIL AND GAS

BRIEFS

POSSIBLE HEBEI RESERVES--Beijing, 23 Apr (XINHUA)--Geologists have found an important clue in their search for oil in western Hubei Province, GUANGMING DAILY reported today. The newspaper said they had discovered a large belt of bioherm, a reeflike mass of limestone, which often indicates the presence of oil and natural gas. The bioherm was found underneath Lichuan County, and was formed from the remains of tiny sea creatures in the late paleozoic era about 280 million years ago. It is more than 60 kilometers long and 5 kilomebers wide. The scientists were reported to be confident about finding rich oil and gas resources in the area. Natural gas had been produced since the 1950s from similar geological formations in southeastern Sichuan Province. [Text] [Beijing XINHUA in English 0706 GMT 23 Apr 86 OW] /6662

OIL FIELD DEVELOPMENT COMPANY--The Qinghai Oil Field Development and Construction Company was set up in March. The establishment of this company is a new step taken by the Qinghai Petroleum Administrative Bureau for carrying out simultaneous prospecting and development and coordinating the exploitation of the oil field. According to our information, feasibility studies have now been basically completed on projects for speeding up the development of the Qinghai oil field. These projects include an oil field producing 1.5 million tons of crude a year, a 400-kilometer-long oil pipeline to Golmud, and the Golmud refinery with an annual refining capacity of 1 million tons of crude. These projects have been officially included in the Ministry of Petroleum Industry's Seventh Five-Year Plan. The oil field development and construction company is currently firming up preparatory work, including capital, for these projects. It is estimated that the commissioning of the Golmud refinery in 3 years' time will change the province's fuel structure. Refinery by products will become available to the people throughout the province. [Text] [Xining Qinghai Provincial Service in Mandarin 2330 GMT 15 Apr 86 HK]

IMPROVED PRODUCT QUALITY--Beijing, 11 Apr (XINHUA)--China plans to build 54 petrochemical installations to improve the quality of products while increasing their variety, according to the overseas edition of the PEOPLE'S DAILY today. For this year, the government will invest 630 million yuan in these projects which, upon completion in the next 2 or 3 years, will earn 1.88 billion yuan annually. Observers say this is an attempt to minimize the loss expected from the recent worldwide slump in oil prices. [Text] [Beijing XINHUA in English 1251 GMT 11 Apr 86 OW] /12858

BOHAI OFFSHORE FIELD--Tianjin, 16 Apr (XINHUA)--North China's Bohai offshore oil field will boost its crude output more than 11 times this year over 1985 -- and 140 times by 1990, an energy official said here today. Speaking at a conference on oil production, Cao Dean, general manager of the Bohai Petroleum Corporation, said the field's annual output will increase from 140,000 bbls to 1.58 million bbls this year -- and to 19.6 million bbls by 1990. The oil field has 530 working wells, including eight added just this year, according to Cao. And, he said, it plans to spend 1.4 billion U.S. dollars over the next 5 years on prospecting and drilling. Although most of the field's investment capital has come from the Chinese government, foreign firms -- from France, Great Britain, Japan, and Norway --have participated since foreign participation began in 1979. "We welcome foreign cooperation," said Cao. Altogether, the field should produce 36.4 million bbls of crude oil and 500 million cubic meters of gas over the next 5 years, he said. [Text] [Beijing XINHUA in English 1646 GMT 16 Apr 86 OW]

NEW SHANDONG WELL--On 3 April the Shengli oil fields brought in a well with a daily crude oil output of 1,013 tons and a gas output of 75,000 cubic meters along Gudong coast. The Gudong oil field, located on the north bank of the mouth of the Huang He, was discovered in 1984 along the coast of the Bo Hai following the discovery of the Huabei oil field. /Summary/ /Jinan Shandong Provincial Service in Mandarin 2300 GMT 3 Apr 86 SK/ 12228

HUABEI OUTPUT REBOUNDS--Shijiazhuang, 7 Apr (XINHUA)--The Huabei oil field, China's third largest, has maintained an annual output of more than 10 million metric tons in the past 10 years. Since it began operations in 1976, output of the oil field once exceeded 17 million metric tons annually, and then dropped to 10 million metric tons due to various reasons. After scientists and technicians at the oil field employed modern technologies to improve prospecting and production techniques, the oil field's output rebounded to 10.31 million metric tons last year, and another 230 million metric tons of crude have been added to the oil field's deposits in the last 5 years. /Summary/ /Beijing XINHUA Domestic Service in Chinese 0912 GMT 7 Apr 86 OW/ 12228

QAIDAM STRIKES--Xining, 5 May (XINHUA)--Two oil fields, with estimated reserves of at least 140 billion bbl, have been found in the western part of the Qaidam Basin, Qinghai Province, local petrogeologists announced here today. They are located in the Nanyishan and Shizigou areas. So far, one well has been drilled in each of the areas. Oil gushed forth when the well in Manyishan reached 2.981 meters. It gives a daily oil output of 5,000 bbl in addition to a large amount of natural gas. High-quality oil accounts for more than 71 percent. The 4,564.5-meter well in Shizigou produces more than 700 bbl of oil a day. Now drilling has been begun for a dozen wells planned in the areas. There is an oil-potential area of more than 100,000 sq km in Qaidam. [Text] [Beijing XINHUA in English 1225 GMT 5 May 86] /9604

CSO: 4010/52

NUCLEAR POWER

LACK OF FOREIGN CURRENCY MAY HOBBLE POWER PLANT PROGRAM

HK111025 Hong Kong AFP in English 0833 GMT 11 Apr 86

[Report by Pierre-Antoine Donnet]

[Text] Shenzhen, China 11 April (AFP) -- China plans to enter the world market to sell nuclear power plants when it masters the necessary technology, a nuclear industry ministry official said Friday.

Liu Shulin, who is heading a delegation to a high-technology exposition which opened here Thursday, also gave the first official confirmation that China's nuclear power program would be slowed due to depletion of foreign currency reserves needed to finance it.

Mr Liu, a former vice-minister in the nuclear industry, told a press conference that in particular China could export nuclear power plants with 300-megawatt capacity similar to the one now being built at Qinshan near Shanghai, and would offer competitive prices.

Work on the Qinshan power station was making good progress and would be completed in 1989, he added.

Mr Liu also said that China, with rich uranium reserves exceeding domestic needs, planned to export 1,000 tons of nuclear fuel a year and that several countries had already expressed interest.

China recently signed letters of intent with Framatome as well as with the British company General Electric, on construction of its first major nuclear power plant at Daya Bay near Hong Kong.

But Mr Liu said that construction of a second large nuclear power plant at Sunan in eastern China was not included in the 5-year plan for 1986-1990, chiefly because of the foreign currency expenditure involved and a move away from the excessive imports of the previous 5-year plan.

The French company Framatome and the West German firm KWU have already conducted detailed negotiations with China on this project.

China had originally planned to build 10 nuclear power plants with 1,000 MW capacity each by the year 2000.

China exploded its first atomic bomb in 1964 but still does not have a nuclear power plant in operation. It is building the power plant at Qinshan without foreign assistance, but requires foreign technology for construction of larger plants.

Mr Liu said that when the Daya Bay plant starts up, security guarantees, including those covering environmental protection, would be at a level comparable to those governing the operation of nuclear power plants in Western countries.

The official also stressed that one of the tasks of his ministry would be to redeploy to the civilian sector more than 10,000 researchers and technicians who had been working since the 1950's on developing the country's nuclear arsenal.

Most Chinese nuclear exports were trained in the Soviet Union before the rupture between the two communist giants in 1960.

Some 60 percent of production of China's nuclear industry is currently used in the military sector, but the civilian sector's share is due to rise from 40 to 60 or 70 percent over the next 5 years, the official said.

Products for civilian use manufactured by China's nuclear industry are being featured at the China Shenzhen Technology Fair which runs until 20 April in this southern special economic zone.

More than 200 products manufactured by 80 companies dependent on the nuclear industry ministry are on display at the fair.

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CSO: 4010/46

NUCLEAR POWER

DESIGN, BUILDING DETAILS OF QINSHAN POWER PLANT PRESENTED

Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 6, No 6, Dec 85 pp 481-489

[Article by Ouyang Yu [2962 7122 0056]]

[Text] I. Introduction

The Qinshan Nuclear Power Plant is a Chinese-designed and Chinese-built prototype power plant; its rated power output is 300,000 kW. After completion, it will be linked to the East China power grid. It is expected that through the research, design, construction, and operation of this nuclear power plant, China's nuclear industry will benefit in terms of improving its organization, acquiring experience, training personnel, and becoming systematically more proficient in nuclear power technology. Furthermore, it will also facilitate the assimilation of foreign nuclear power technology. Therefore, this project is of paramount importance with regard to both scientific technology and China's economic development.

II. Description of the Plant Location

The power plant is located in Qinshan, Haiyan County, Zhejiang Province; it is 126 km from Shanghai by highway and 92 km from Hangzhou. To the northeast of Qinshan is Hangzhou Bay; the main peak has an elevation of 185.5 m. To the north are low hills which can be flattened so that the main building of the plant will be situated on a rock foundation. To the northwest of the main building is a stretch of beach; a 9-meter-tall, 1,780-meter-long dyke will be constructed in a northwest-southeast direction to enclose 566,000 m^2 of land for auxiliary buildings such as waste solidification treatment plant, air supply, steam supply and cooling facilities as well as spare parts and repair shops. Fangjiashan to the west of Qinshan can be used for future expansion.

The region surrounding the plant has a very stable geological structure; the rock layer where the main plant is located has a slope of 18 percent. The compressive strength of the lock is greater than 10,000 kg/cm^2. The beach area is made of sludge particles and subclay; its load capacity is approximately 8 $tons/m^2$. The hydrological and geological conditions of the terrain near the plant are relatively simple. The base is made of molten rock which has poor permeability. The average temperature in this region is 15.8 C; the historical low temperature recorded is -10.8°C, and the high is 38.1°C. The average rain-

fall is approximately 1,076 mm. The prevailing wind direction is east-southeast; in the summer, typhoons may bring severe storms with wind velocities as high as 32.2 m/sec.

In terms of hydrology, Hangzhou Bay is a semi-enclosed area with typical characteristics of a river outlet. The tides rise and fall twice per day, and the average temperature is 18.1 C. The cooling water for the condenser is taken from the nearby trough along the seashore and the warm water is returned to the bay. Because of the large tidal velocity (3-4 m/sec), the ejected warm water is thoroughly dissipated. Fresh water is taken from the Changshan Canal located 10 km from the plant; there is an ample supply of fresh water because the canal is connected to Tai Hu, and the Grand Canal, and the Huangpu Jiang.

Population distribution. The population distribution and population density within a 50-km radius of the plant are shown in Table 1. As is well known, the East China region is China's most populous region; compared to the surrounding regions, the population density near the plant location is relatively low, particularly within an area 20 km from the plant. For example, the average population density of Zhejiang Province is 376 persons/km^2, which is higher than the average population density in an area 30 km from Qinshan; the average population density of the 11 neighboring counties is 569 persons/km^2, which is higher than the average population density in an area 50 km from Qinshan (500 persons/km^2).

Table 1. Population Distribution and Population Density Within a 50-km Radius of the Qinshan Power Plant

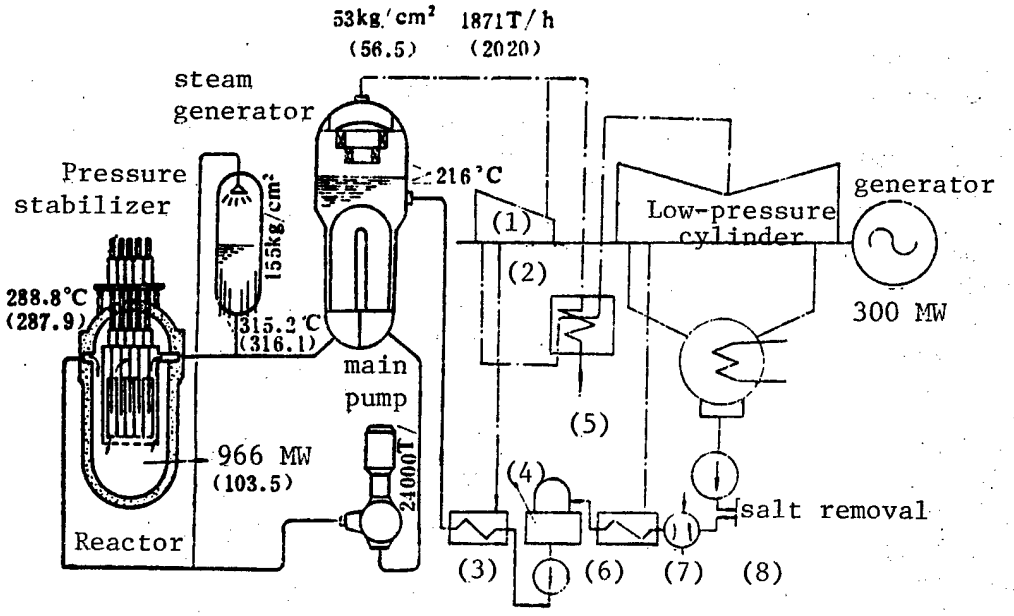
Distance km	4—0.5	0—1	0—2	0—5	0—10	0—15	0—20	0—30	0—40	0—50
Cumulative population	0	287	2816	18725	85994	182381	319335	870327	2070611	3924003
Population density	0	91	224	238	274	258	254	308	418	500

The power generator of this power plant consists of three major segments: the pressurized-water reactor (PWR), the primary circuit system, and the secondary circuit system (Figure 1). The cooling water for the reactor and the primary circuit is under a pressure of 155 kg/cm^2 and has an average temperature of 302 C. The nominal thermal power of the reactor is 966,000 kW at a nominal flow rate of 24,000 tons/hr; it is expected that with sufficient operational experience, it can be increased to 1.035 million kW. The flow rate of steam in the secondary circuit is 1,870-2,020 tons/hr, and the pressure is 53.0-56.5 kg/cm^2. The steam can produce 300,000-330,000 kW of power.

1. Reactor

The reactor unit consists of the reactor core, the reactor interior members, the pressure shell and the control rod drive mechanism (Figure 2). The reactor core is a structure which has 121 fuel elements arranged in a square array with a near-circular cross section. The water-to-uranium ratio in the reactor core (V_{H2O}/V_{NO2}) is 2.0653; the total capacity of NO_2 is 40.744 tons.

Figure 1. Power Generator of the Qinshan Power Plant



Key:

1. high-pressure cylinder
2. steam/water separator and regenerator
3. high-pressure heater
4. oxygen
5. to steam trap
6. water supply pump
7. low-pressure heater
8. air evacuation unit

The first reactor core has three different concentration levels (2.4 percent, 2.672 percent, 3 percent), and the subsequent balanced refueling elements have a concentration level of 3.4 percent. The fuel rods are arranged in a 15x15 square array with 13.3 mm separation between two neighboring rod centers. The shell is made of Zr-4 alloy pipes with 10-mm outside diameter and 0.7 mm wall thickness.

During the design, a series of experiments were conducted to determine the physical, thermodynamic, hydraulic and material characteristics as well as the mechanical properties of the reactor core and the fuel elements in order to verify the reliability of design and to make design improvements based on the test results.

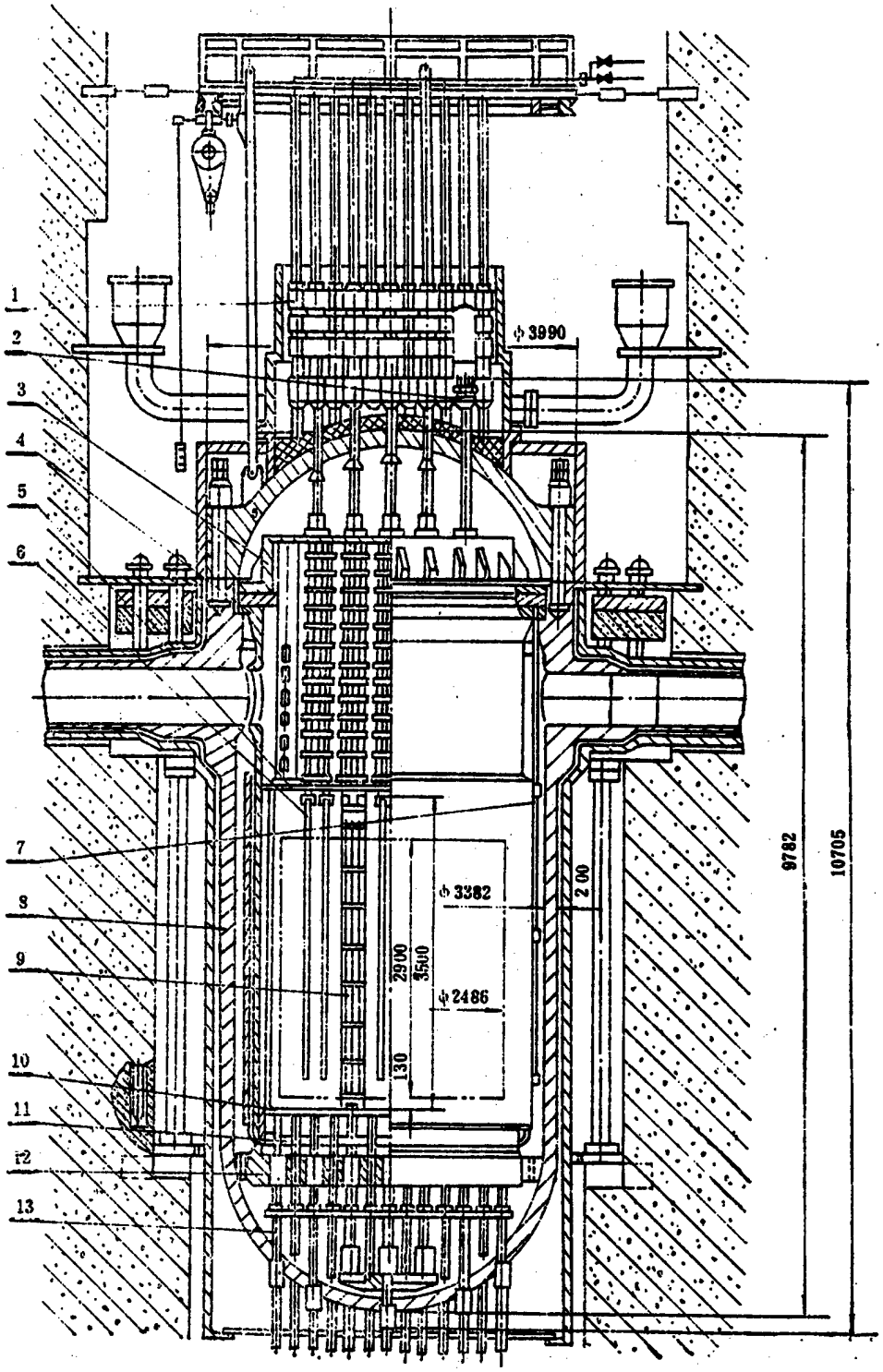
Two different approaches are used in the reactor to control reactivity: the use of bundle type control rods and dissolved boron. The drive mechanism for the control rods is magnetically operated, and has been tested for over 10,000 m continuous travel. Its performance has been demonstrated in terms of wear-resistance, endurance and reliability.

The interior members of the reactor are used to position the reactor core and to guide the coolants through the reactor core; they are also used to guide the 37 bundles of control rods. In addition, 41 thermocouples (for measuring

Figure 2. The Reactor

Key:

1. control rod drive mechanism
2. reactor temperature sensors
3. clamped parts
4. hanging basket
5. upper plate of reactor core
6. control rods
7. radiation monitoring tube for pressure shell material
8. pressure shell
9. fuel elements
10. lower plate of reactor core
11. flow distribution plate
12. bottom plate of hanging basket
13. neutron flux measurement unit inside the reactor



the exit coolant temperatures of the fuel elements), 30 neutron flux measuring tubes and 8 radiation monitoring tubes are installed.

The pressure shell is made of SA-508-III steel, with semi-spherical enclosures on both top and bottom. It is 10.705 m in height, the outside diameter of the cylinder is 3.732 m, and the wall thickness is 175 mm; its design is based on U.S. ASME standards. The pressure shell has two major components: the cover and the cylindrical container, which are joined together with bolts and sealed with two concentric O-rings. The entire shell is made of forged parts to avoid weld lines in the longitudinal direction. In order to minimize embrittlement of the weld lines due to neutron radiation, they are positioned so that direct exposure to the reactor core would be avoided. During the design, stress analysis of the pressure shell was performed using the method of finite elements; also, electric tests and photoelastic tests of a 1:4 scale steel model and a 1:10 scale plastic model were conducted. These analyses and tests showed that the designed pressure shell exceeded the pressure requirements of the ASME-III specifications with ample margin. The pressure shell was manufactured by the Mitsubishi Engineering Co of Japan; Mitsubishi had verified and approved the Chinese design.

2. Primary Circuit System

The primary circuit system consists of two parallel loops. Each loop contains a steam generator and a main coolant pump, which are connected by No 316 stainless steel pipes to the reactor to form a closed circuit. In addition, the system has a pressure stabilizer and pressure relief tank as well as instruments and valves required for operation control and safety.

The steam generator is of vertical inverted U design; its upper section has a 3-stage vapor/water separator. The separator has been tested using moist, hot steam; the separated steam is 99.9 percent free of moisture, which exceeds design requirements.

The main pump is a vertical, single-stage, single-speed mixed type sealed-axle pump. The axle has three mechanical seals; if any stage fails, the remaining stage(s) will still be able to withstand the pressure in the system. The main pump is designed and built by the KSB Pump Factory of West Germany according to our specified parameters and requirements.

The pressure of the primary circuit is regulated by the pressure stabilizer. The electric heater, the atomizer and other equipment of the regulation system have been tested repeatedly for performance and reliability. The top section of the pressure stabilizer is equipped with three electromagnetic pressure relief valves and two safety valves to protect against over pressure.

In addition to the main system, the primary circuit has 16 auxiliary systems. Functionally, they can be divided into the following categories;

(1) Systems to ensure normal operation and porper starting and stopping of the reactor and the primary circuit; they include the chemical volume system, the boron retrieval system, the sealing system of the main pump axle, the water

disposal system, the cooling system for the equipment, the cooling system for removing residual heat after reactor shut-down, and the ventillation system for the workshop.

(2) Systems to protect the reactor and the primary circuit when loss of water occurs, to contain the effects of an accident, and to prevent scattering of radioactivity into the environment; they include the safety injection system, the safety sprinkling system, and the hydrogen removal system.

(3) Systems to retrieve and process radioactive materials to protect the environment; they include the collection, purification and storage systems for waste gas and liquid waste, and the solidification system and processing system for liquid waste and solid waste.

3. Secondary Circuit System

The main component of the secondary circuit is the steam turbine-generator unit. The steam turbine is a single-axle, three-cylinder, four-exhaust condensation type saturated steam turbine. The generator is a dual-water, internally cooled, brushless excitation, three-phase, a.c. generator. Its terminal voltage is 18 kV, and its rotational speed is 3000 rpm.

Between the high-pressure cylinder and the low-pressure cylinder of the steam turbine are two heaters which are designed to remove the moisture and raise the temperature of the steam. When the turbine pressure increases due to sudden loss of load, 70 percent of the steam will be exhausted rapidly into the condenser to avoid excessive shock on the reactor due to the load change. In case of a crack in the main steam pipe, the steam flow rate will be limited by the flow limiter located at the exit of the steam generator in order to minimize the effect of excessive cooling of the reactor due to the loss of steam.

Since the cooling water used in the condenser is sea water, the heat transfer pipes and plates are made of titanium. Also, to ensure the quality of the water supply, the condensation water will be subject to 100 percent salt removal.

IV. Safety Design Measures

Safety has always been the No 1 consideration in the design of this power plant; the first priority is safety, not high performance. In conjunction with preliminary design, preliminary safety analysis and evaluation of environmental effect were also conducted, and accident prevention measures and emergency procedures were established. Safety design measures are generally based on the international standards used in the late 70's. They are also in compliance with the Chinese safety standard "Radiation Protection Regulations."

1. Safety Design Guidelines

The safety design follows the four guidelines described below.

(1) Eliminate possible causes of accident. A good design and superior engineering quality are pre-requisites for ensuring safety. This power plant is equipped with many levels and many different types of safety devices. Sufficient safety margines are provided for critical materials and critical components, and strict quality inspections are conducted to minimize the possibility of accidents.

(2) Prevent conditions of abnormal operations from developing into catastrophic accidents. Multiple levels of independent safety protection and control systems are installed so that when operational parameters exceed their design limits, alarms will be activated and power output will be automatically reduced until the reactor is shut down. Constant monitoring and periodic inspection will be carried out; procedures will be established for safe operation, particularly procedures to prevent abnormal operating conditions from developing into major accidents.

(3) Minimize damages in case of an accident. Accident correction measures are taken for every possible cause of accident in order to prevent radioactive materials from polluting the environment. In addition, effective protective measures must be taken to guard against possible natural disasters such as earthquakes, tides, floods, and typhoons, to ensure that safety-related structures, systems, and equipment will not be damaged and fail to function.

(4) Close monitoring of radiation dosage and radiation protection. Radioactive waste treatment and purification systems, dosage monitoring systems, and protective shields are installed in order to control and ensure that the radiation level released during normal operation and in case of an accident will be lower than the allowable levels specified in the standards 10CFR20 and 10FR100, and in China's Radiation Protection Standards, so that the safety of operating personnel and local residents can be guaranteed.

2. Safety Measures

The following safety measures are taken in the design:

(1) The reactor has negative-response temperature coefficients. In order to maintain good stability during operation of the reactor, and to limit boron concentration in the coolant, burnable poison rods are installed during initial loading of the reactor core, so that the temperature coefficients of the moderator under various operating conditions and all negative. Specifically, these values are as follows:

At initial fuel loading	$\alpha_m^\circ = -1 \times 10^{-5}/°C$
	$\alpha_m^{HFP} = -7 \times 10^{-5}/°C$
Before first refueling	$\alpha_m^{HFP} = -5.19 \times 10^{-5}/°C$

(2) Sufficient margin is provided in the thermodynamic design. The calculated coefficient of power non-uniformity of the reactor based on physical zero-power inspection procedure is 2.54; to provide adequate safety margin, the coefficient for thermodynamic design is chosen to be 2.9.

(3) Protective screens are installed to prevent radioactive materials from escaping. Three individual screens are installed for shielding the fuel elements, the pressure shell and the primary circuit, and the safety shell.

(i) Fuel elements. The fuel elements are made of UO_2 core blocks which have high melting point and very stable chemical properties. The total hydrogen content in the core block is limited to less than 2.5 ppm in order to minimize fracture due to hydrogen embrittlement. The mechanical structure of the fuel elements has been tested for mechanical strength, water corrosion, hydraulic surge and hydraulic vibration; it is now undergoing radiation tests.

(ii) Pressure shell and primary circuit. The mechanical design of the pressure shell, the primary circuit and auxiliary systems has adequate safety margin. All metallic surfaces in contact with the coolant are made of austenite stainless steel or high-nickel alloys; the quality of water in the primary and secondary circuits is strictly controlled to minimize corrosion. The structural materials, the weld lines and the reactor weld layers of the components and support members have been subject to non-destructive tests according to ASME Class-I technical standards; they are also subject to periodic inspection during operation in order to discover hidden defects and take timely corrective measures.

(iii) Safety shell. The safety shell is a pre-stressed concrete structure which can withstand the combined load of 1.4 times the peak pressure under loss-of-water conditions plus its own weight, the pre-stress, and the temperature stress. This combined load is supported by several hundred bi-directional pre-stressed steel bars. The entire shell structure has been subject to detailed stress analysis, and conventional steel ribs have been installed based on the analysis results to reinforce the structure, so that the safety factor of structure under pressure loads of an accident is no less than 2.0.

Sealing of the safety shell is accomplished by the steel rib lining on the inner surface. The strength and stability of the steel lining have been carefully analyzed under the pressure load of an accident, temperature pressure, and pre-stress. The several hundred tubes which penetrate the safety shell must also meet very strict sealing requirements. After completion, the safety shell will be subject to strength test and overall leakage test. Under design pressure, the allowable leakage rate is one-one thousandth of the total weight of air inside the safety shell in a 24 hour period. The leakage test will be repeated every few years after the plant begins operation.

(4) Reactor safety protection system. The reactor has 37 bundles of control rods, which can be inserted into the reactor core in 2 seconds under gravity. When the operating parameters exceed their design limits and there is a possibility of endangering the pressure boundaries of the reactor core and the primary circuit, the automatic reactor shut-down signal will cause the control rods to be lowered to provide sufficient depth of thermal shut-down. When shut-down occurs, a signal is generated to stop the steam turbine at the same time.

(5) Special safety measures. In order to prevent reactor core melt-down and to prevent the release of radioactive materials into the environment due to loww of water in the primary circuit or fracture in the main steam pipes. the power plant is equipped with special safety measures which include the following systems:

(i) Safety injection system. The system has four high-pressure safety injection pumps, two low-pressure injection pumps and four safety injection tanks. In case of an accident, the high and low pressure safety injection pumps will inject boron water into the reactor core according to pressure variations in the primary circuit. When the pressure drops to 50 atg, the four safety tanks automatically inject boron water into the reactor core.

(ii) Safety sprinkling system. The system has two safety sprinkling pumps. When the internal pressure of the safety shell rises to 1.5 atg due to loss of water, the sprinkling pumps are activated and boron water containing NaOH is sprayed into the safety pump.

(iii) Safety shell isolation measure. In the case of loss of water in the primary circuit or fracture of the main steam pipes, a safety shell isolation signal is generated in addition to the safety injection signal (isolation of all the conduits except the steam pipes, water supply tubes, and ventillation system conduits). The main steam pipes and water supply tubes are isolated when a special signal indicating fracture of the main steam pipes is generated; the ventillation system conduit of the safety shell is isolated by a signal indicating high radiation level inside the safety shell.

(iv) Hydrogen removal system. The hydrogen removal system is designed to remove the accumulated hydrogen within the safety shell. There are two closed-loop systems each with a hydrogen removal capacity of 150 m^3/hour; each system contains a suction type blower, an air cleaner, and a catalytic hydrogen and oxygen composite remover. In case of an accident, the hydrogen concentration inside the safety shell can be controlled to below 4 percent by activating only one of the two systems.

(v) Safety air purification system. This system includes:

(a) a safety shell air filtering system, which can filter the air in the safety shell once every 4 hours to reduce the radiation level.

(b) safety shell cleaning and ventillation system, which is used for cleaning reactor personnel before entering the safety shell; its air replacement capacity is 1.5 times/hour.

(6) Reliable power supply. To ensure that the power plant will not lose electricity under any circumstances, three independent electric sources are installed for power supply. They include: two independent external sources from different transformer stations of a 220 kW power network. If the two external sources are cut off simultaneously, then the emergency diesel generator unit within the power plant is activated to supply power to the special safety facilities. There are three emergency diesel engines, each with a capacity of 2000 kW.

(7) Anti-earthquake measures. The anti-earthquake design is based on standards for nuclear power plants used by the U.S. and Japan. All structures, equipment and systems of this power plant are designed according to anti-earthquake specifications. Components which are directly related to the safety of the power plant are designated as class-I components.

The earthquake response spectrum of nuclear power plants specified by the U.S. Atomic Energy Commission are used in the design. Specifically, two reference intensities are assumed. One is the operational base earthquake (OBE), which is the maximum earthquake intensity that might be encountered at the plant location over the next 100 years; this value is consistent with the base intensity of scale 6 (AH$\sim$.075g) approved by the National Earthquake Bureau. The other value is based on the maximum intensity at the plant location which had been recorded in history and which may be encountered in the future; this intensity plus one defines the safety shut-down earthquake (SSE).

For anti-earthquake and anti-fracture considerations, a 300-ton and a 40-ton pressure dampers are included in the system design.

In addition, specific anti-earthquake requirements are also used in designing various equipment as well as their supports and valves. Special analysis and calculations are performed for Class-I structures, equipment and conduits to eliminate any hidden concerns.

(8) Fire-fighting measures. The fire fighting system of the power plant is designed according to the No. 50-SG-D nuclear power plant fire prevention regulations of the International Atomic Energy Organization and the Chinese "Construction Design Fire Prevention Regulations" TJ16-74; the U.S. NRC Regulatory Guide 1.120 is used as a reference.

Non-combustible construction materials are used. For critical areas such as the control room, the electric cable compartment in the computer room, and the diesel engine room, fire-proof insulation screens are installed to provide fire resistance for more than 3 hours. The control room, the switch room and the transformer room are equipped with fire detection sensors which can automatically activate the alarm; they are also equipped with automatic fire extinguishing systems.

(9) Protective measures against floods, typhoons, and impact of external objects. The effects of tides and typhoons must be given serious consideration. Sea dykes are being built along the shore and will be connected to the existing dykes. The dyke design is based on considerations of high tides that occur once every hundred years and wave heights with corresponding frequencies; the design is verified using once-per-thousand-year high tides plus wave heights with once-per-hundred-year frequencies to ensure safety of the power plant.

In addition, loads due to typhoons, tornados and impact of external objects are also considered in the building design. Analysis results show however that these effects are all smaller than the earthquake loads.

(10) Lessons learned from the Three Mile Island incident. The following measures are taken in arranging the control room.

(i) The control room is arranged according to system functions; instruments for normal operation and emergencies and their respective controls are clearly arranged on the control console and the instrument panel.

(ii) Redundant arrangement is provided for critical instruments so that malfunctioning of one instrument will not lead to incorrect decision.

(iii) For added fire protection, an emergency control room is provided in addition to the main control room.

(iv) Safety-related equipment are located so that the operators can have easy access.

(v) Indicator lights are installed near the controls to attract the attention of operators when abnormalities occur.

(vi) CRT displays are utilized to enhance man-machine interaction, to indicate the status and parameters of malfunctions, and to direct the operators so errors are avoided.

(vii) Technical support centers will be established to provide direction and guidance in case of an accident without interfering with normal operation.

3. Accident Analysis

The accident analysis for this power plant is performed according to specifications of the U.S. standards ANSI-18.2, "Nuclear Safety Design Rules for Fixed Pressurized-Water Reactors."

On the basis of the expected frequency of occurrence and the degree of seriousness, accidents can be divided into three categories: (1) extreme accidents (postulated accidents which are not expected to occur); (2) major accidents (accidents which occur rarely); and (3) general accidents (accidents with medium frequency of occurrence).

To be safe, the accident analyses are carried out by assuming exagerated degree of seriousness and unfavorable conditions, without regard to the actual probability of occurrence of these scenarios. For example, in the case of an accident where fracture of pipes, earthquake, and loss of electricity all take place at the same time so that the reactor must be shut down, it is assumed that a bundle of control rods with the largest reactive value becomes jammed and cannot be inserted into the reactor core. The initial conditions and the physical, thermodynamic parameters are generally chosen to have the most unfavorable values under the particular operating conditions.

During the preliminary design phase, 6 extreme accidents, 7 major accidents and 6 general accidents were analyzed, with emphasis on the extreme accidents and major accidents. The computer programs used in the analyses were developed by the Shanghai Nuclear Engineering Research and Design Institute, with the

exception of the imported RELAP-5 program, which was used for analyzing a loss-of-water accident in the primary circuit. The results of analyses were generally quite satisfactory. For example, a comparison of the analysis results and safety standards for two accident scenarios--dual fracture of the main pipe in the primary circuit and medium, small punctured holes in the pipe--is shown in Table 2. The analysis results for all accident scenarios considered met the specified safety standards.

Table 2. LOCA Accident Analysis Results

Safety standards	Analysis results	
	Dual fracture	Medium and small punctured holes
Maximum fuel rod temp. <1204 C°	= 1098°C	852°C
Zirconium-water reaction <10%	<1%	<1%
Max. thickness of zirconium oxide <17%	≤3.52%	negligible
Reactor core maintaining coolable geometric shape	yes	yes
	L-LOCA	RELAP-5

4. Evaluation of Environmental Effects

The treatment of gas, liquid, and solid waste and environmental protection for the power plant strictly follow the principle of "ALARL." The waste treatment system is generally identical to similar systems used in the U.S. Under normal operating conditions with no leaks in the heat transfer pipes of the steam generator, the concentration in the waste water is 2.05×10^{-9} Ci/L; the annual discharge is only 0.012 Ci (with the exception of tritium). When there is a leakage of 3.17 L/h from the steam generator and 0.5 percent damage to the fuel rods (extreme operating condition), the maximum concentration in the waste water is 2.2×10^{-8} Ci/L, and the annual discharge is 3.65 Ci. The waste water is diluted by the circulating water until the concentration is reduced by three orders of magnitude before it is discharged into the sea.

Similarly, by assuming extreme operating conditions, it is calculated that the effect of discharged waste water on the local residents is to produce a maximum dosage of only 0.03 mrem, the effect of discharged gas is 0.37 mrem, with a total of 0.4 mrem. This value corresponds to only 0.4 percent of the natural background radiation.

In addition, analysis of the radiation levels in the environment from 8 major accidents and extreme accidents showed that they are far below the threshold value given in the U.S. regulations 10CFR20 and 10CFR100. Therefore, the safety of the Qinshan power plant is reasonably assured.

V. Project Development

The development plan of this power plant was reviewed and approved by the late Premier Zhou Enlai in 1974. Since that time, significant amount of research and tests have been conducted, and a plant site has been selected. Of the planned research tasks, approximately 200 have been completed by mid-1982 (at the end of 1984, 220 have been completed), and Qinshan was selected as the site for the power plant. On this basis, preliminary design (including preliminary safety analysis) and manufacturing and procurement of equipment and components were initiated. The preliminary design was completed in October 1983, and was approved by the National Planning Committee in January 1984. Construction design has been underway for over a year, and is still continuing. In June 1983, work began in excavation, field preparation, dyke construction, and the construction of water supply, power supply, and roads; by the end of 1984, they were all completed. In January 1985, construction of the main plant was officially started, and factories in Shanghai, Beijing, Xi'an, and Dalian also began manufacturing of various equipment for the power plant. It is expected that construction will continue for 2 more years through 1986, installation will also take 2 years through 1988; test operation should begin in early 1989. If everything proceeds according to plan, the power plant is expected to begin generating power in the second half of 1989.

The author would like to express his thanks to comrades who are concerned, and who have provided guidance, support and assistance to the Qinshan project.

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NUCLEAR POWER

CONSTRUCTION STEPPED UP ON QINSHAN, DAYA BAY POWER PLANTS

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 22 Apr 86 p 1

[Text] Beijing, 21 Apr (XINHUA SHE)--Progress on the project to construct China's first nuclear power plant--the Qinshan Nuclear Power Plant--has been rapid. The nuclear island, the heart of the power plant, stands like a colossus over the construction site.

According to a report in the Shanghai WEN HUI BAO, as of the middle of April the steel framework for the nuclear island had risen to a height of 31 meters, one-half of its overall [finished] height. Concrete for the nuclear island has already been poured to a height of 12 meters, or about 23 percent of the total to be poured. Work on the auxiliary building is well under way and work is progressing on the main control room, the seawater pumping station, the water intakes, and the waste material storage facility.

Located on the northern shore of Hangzhou Bay, the Qinshan nuclear power plant is 92 kilometers from Hangzhou and 126 kilometers from Shanghai. It is the first 300MW pressurized-water reactor power plant to be Chinese-designed and built, and is listed as one of the nation's major construction projects. Work on the main buildings of the Qinshan nuclear power plant began in January 1985. Tests are scheduled for 1989 and the plant could be feeding power into the grid that same year.

According to a CHINA NEWS AGENCY report from Guangzhou on the 21st, preliminary engineering work on the Guangdong nuclear power plant, which has been going on for 2 years, could be completed by the end of April [1986].

Preliminary engineering work on the Guangdong nuclear power plant at Daya Bay began in April 1984. Today, the 67-meter hill that used to be on the Daya Bay site has been levelled and a flat, broad plant area has now risen some 6 meters from an area reclaimed from the ocean that covers an area of 197 hectares. Construction of an immense stone and concrete block seawall that measures 1400 meters in length and 14 to 16 meters in height has commenced. A "water curtain" that is 1000 meters long, 80 centimeters thick, and 12 to 16 meters deep has also been finished. Already in use is a 1000-ton-capacity pier. A 4-meter-wide asphalt highway running some

28 kilometers from the Beizijiao border inspection station to the plant site has been finished. A newly built 35,000 volt transformer station assures a supply of electricity for the construction work. Telephone and radiotelephone links to Shenzhen are now open. A 1.3 million m^3 reservoir and its associated water works have been completed and pipelines are now being put down.

The Guangdong nuclear power plant project has been removed from the Ministry of Water Resources and Electric Power and placed under the authority of the Ministry of Nuclear Industry. A new management system is also being established. Currently, tenders are being invited for the civil engineering work on the basic work of the nuclear reactor.

/9604
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SUPPLEMENTAL SOURCES

STATUS OF SOLAR ENERGY UTILIZATION RECAPPED

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 1, 28 Feb 86 pp 1-5

[Article by Liu Jianmin [0491 7003 3046], "The Situation in Developing the Use of Solar Energy at Home and Abroad"]

[Excerpt] Solar energy is a renewable energy source and it is inexhaustible. In the seventies, due to the world oil crisis, the use of solar energy attracted world attention, especially the use of solar energy heat and the sun's light to generate electricity and this has already become an important aspect in the developing uses of solar energy. To promote solar energy in China, the general situation in the development of the use of solar energy in China and abroad will be summarized below.

I. Development of the Use of Solar Energy in China

China began research in the fifties on such uses of solar energy as solar stoves, solar water heaters, and solar batteries. Nation-wide, there are at present 162 research units and over 3,000 scientists and technicians pursuing research units and over 3,000 scientists and technicians pursuing research on the use of solar energy, more than 50 plants produce equipment that uses solar energy, and a total of 40-50 million yuan has been invested by state and local governmental agencies. International academic exchanges concerning solar energy use are also increasing daily. Solar water heaters, solar greenhouses, solar stoves, solar houses, solar dryers, and solar batteries have gradually gone from laboratory research to small-scale application with good economic results.

A. Use of Solar Heat

Solar heat is the most important aspect of the use of solar energy in China today. In the past few years, the important projects which have been progressively promoted and applied are:

1. Solar Water Heaters

China began to develop this already in the fifties. Starting with the early seventies, the solar water heater was progressively promoted and used on a small scale in many places nation-wide. According to incomplete figures, by

the end of 1984, the solar water heaters in use nation-wide exceeded 300,000 m^2. The range of uses, which initially were primarily for supply of low water temperature water for such public facilities as municipal bathhouses, barber shops, dining rooms, and hospitals, has progressively expanded to swimming pools and such industrial and agricultural production as low-temperature fermenting, washing of industrial products, and hot water supply to dairies.

The current average thermal efficiency of hot water heaters being designed and produced in China is 40-50 percent, their price and life expectancy vary depending on materials used, but the maximum price is approximately 100-200 yuan/m2, and the life expectancy is generally 2-5 years.

2. Solar Stoves

China began to develop these in the fifties. According to incomplete statistics, by the end of 1984, there were 90,000 solar stoves nation-wide, and China uses more solar stoves than any other country in the world. Of this number, 40,000 are in Gansu Province, 15,000 are in the rural areas of Hebei Province, but of this number, probably one-third are defective and abandoned.

3. Solar Greenhouses

In the past few years, due to developments in the plastics industry, various types of solar plastic heating tents have been built across the northern and southern regions of China. Their uses have expanded from horticulture to cultivating vegetables and melons and such crop seedlings as cotton and paddy rice, and gradually are used for raising poultry and domestic animals, and cultivating fish, shellfish, and silkworms, all with good results.

By the end of 1983, China had already extended solar greenhouses of various structures and solar plastic tents of various kinds to over one million mu. We will now summarize the developmental trends in use and management.

a. Solar greenhouses for cultivating vegetables. This is the major application of solar greenhouses in China and over 50 kinds of fresh vegetables are cultivated. In high plains regions, the economic benefits are especially clear. These greenhouses cost approximately 3 yuan per square meter to build. For example, the Weidong Office in Lhasa built a plastic greenhouse which covered a half a mu, there are three crops per year consisting of 130,000 catties of cucumbers per crop, which sell for 3,900 yuan, and one crop covers the total investment.

b. Solar-powered fish culture. The Hengshui Special District, Hebei, Acquatic Products Experiment Station uses solar greenhouses to raise fish and after 8 years of tests, the maturation rate of the fry is 99.5 percent, which is a 30-50 percent improvement over coal-heated greenhouses.

c. Solar-powered shellfish culture. The Tianjin Solar Energy Technology Research Conference converted a 240 m^2 artificial prawn hatchery from using

conventional energy sources for cultivation into a solar green house and by using a solar water heater to raise the temperature of the pond water, with the addition of appropriate supplemental electrical heat, moved up the cultivation of prawns in the north by one month and since the autumn crop could be lengthened to 12 cm, it raised the export value of the prawns.

d. Solar-powered hotbeds. These are mainly used for growing spring season seedlings, cultivating winter season vegetables, overwintering of flowers and grasses, vegetative cultivation of cotton seedlings, forcing paddy rice, overwintering of old sweet potato vines, and winter seed protection and breeding in breeding enterprises. Experience proves that by using this type of bed for growing seedlings, the survival rate is higher, the seedlings are more robust, and generally output is increased 6-15 percent.

e. Solar-heated enclosures for raising domestic animals. This can increase the number of sow farrowings from two litters per year to five litters every 2 years; it ensures the normal growth of fattening pigs. It has now been extended to raising milk cows and lambing sheep. Because of its technical simplicity, clear benefits, and low cost, it is being promoted in Shanxi and Neimeng.

4. Solar Houses

China's first passive solar house was built in 1977. According to incomplete statistics, by the end of 1984, over 130 solar homes of different designs have been built nation-wide. Most of them use trombe walls or heat collecting walls.

The energy saving effectiveness and additional investment for China's solar houses varies depending on the region and building style.

When the average outdoor temperature in January was -10°C, the Minqin solar house in Gansu Province, could maintain an indoor temperature above 16°C, with a solar energy supply rate of approximately 80 percent, and a construction cost per square meter generally 10-12 yuan higher than equivalent ordinary houses. The Quanji solar house in Qinghai has a total area of 126 m^2, with a heating area of 57 m^2, and the added investment for using solar heating was 3,000 yuan. When the air temperature outside is -15°C, without using the supplemental heat source at all, the inside temperature can be maintained above 10°C, with an annual saving of 12 tons of coal and at current coal prices the investment can be completely recovered in 3 years. At the Yihezhuan solar house test project in Daxingxian, Beijing Municipality, the interior temperature during the winter without using supplemental heat generally was not lower than 8°C, with a solar energy supply rate over 60 percent, had an added cost of 25 yuan per square meter.

Generally speaking, the usual winter heating temperature in China's solar houses can be maintained at 8-12°C, which meets the demands of the general rural lifestyle, the solar power supply rate is 50-80 percent, and the added investment per square meter is 10-25 yuan.

5. Solar Dryers

China began research on solar powered drying technology and by the end of 1983, over 50 solar dryers with an area of 3,000 m^2 had been constructed nation-wide. They are used for drying such crops as grains, fish, tobacco, rolled bean milk cream, fruits, wood, hides, Chinese medicines, rubber, and natural silk, with good economic benefits. Currently, the better solar drying facilities includes the following.

a. Solar fruit drying facilities. The lichee and longan solar dryers of the Dongwanxian Fruit Processing Plant in Guangdong have a total area of 59 m^2. The drying time reduced by two-thirds over that of traditional drying methods, saving energy as well as improving product quality, so that the product can reach the special class or first class standard. The investment per square meter in this facility was 150 yuan, and the total investment can be recovered in 1-3 years.

The solar hongzao [4767 2764] drying facilities of the Taocun Brigade of Houshanxian, Shanxi, can save a standard ton of coal in drying 1 ton of hongzao.

b. Solar curing facilities. The investment in a 213 m^2 solar rabbit skin curing facility in Hebei was 180,000 yuan recoverable in a year. Experience proves that compared with natural drying or tedding, rabbit skins are cleaner when dried in a solar dryer, the drying time is shorter by two-thirds, and the losses can be reduced.

c. Solar tobacco-drying facilities. Ordinarily, drying 1 ton of tobacco requires 1 ton of coal. In Henan alone, the annual consumption of superior coal for drying tobacco is more than 1 million tons. But using solar energy for drying tobacco can both improve the quality of the tobacco and also save a great deal of coal.

d. Solar wood drying facilities. The solar-powered infrared wood drying kiln of the Yuncheng Municipal Wooden Articles Plant in Shanxi has a capacity of 7 m^2. The results of operation show that, compared with drying in coal-fired kilns, drying costs dropped from 22 yuan/m2. Total investment is recoverable in 3 years and at the same time the quality of the wood drying is improved.

6. Solar-powered Sea Water Desalinization Facilities

The Guangzhou Energy Institute of the Chinese Academy of Sciences has built solar-powered sea water desalinization facilities at Hainan, Zhongjian Island in the Xisha, and in Zhejian.

7. High-temperature Solar Furnaces

In 1978 the Hai'anxian Solar Energy Institute of Jiangsu developed a solar furnace with a focal diameter of 30 mm, and a focal center temperature of more than 2,000K which can be used for welding. The South China Engineering

Engineering College developed two solar furnaces, mainly for materials testing, which have a maximum focal temperature of 3,000°C.

8. Solar-powered Air Conditioning Facilities

In the past few years, some of China's scientific research units have carried out scientific research on solar-powered refrigeration and ventilation and have obtained some operational experience, but it is still quite far from practical use. The Guangzhou Energy Institute of the Chinese Academy of Sciences has cooperated with the Hong Kong College of Science and Engineering to construct a demonstration solar-powered air-conditioned house in Shenzhen.

B. Solar-powered Photoelectric Uses

In 1958 China began conducting research on solar batteries. In 1971 solar batteries were successfully applied for the first time in the second satellite launched by China. In 1973 this technology was extended to ground applications, the first of which was the navigation lights in Tianjin harbor. Since then it has also been extended to applications in railroads, animal husbandry, communications, television, protecting crops and rubber, with clear results.

There are over 40 units in China pursuing solar battery research, among which most are studying single crystal, non-crystal, and multi-crystal silicon solar batteries, and a few studying solar batteries of chemical compounds, such as cadmium sulfide and gallium arsenide.

At present China has 17 plants which produce solar batteries. Annual productive capacity is above 100 kW, but actual production is 70 kW, and the products are primarily single crystal silicon solar batteries. The overall cost of solar battery products has dropped to 50-55 yuan-peak Watt, with photoelectric conversion efficiency at 8-12 percent, and life expectancy which can reach 10 years. By the end of 1984, the installed capacity of China's solar batteries was over 100 kW.

The applications of solar batteries nation-wide is primarily in the following areas:

1. Navigation Lights

Primarily in harbor routes in Tianjin, Shanghai, Guangzhou, and Chang Jiang. By the end of 1983, the overall power of silicon solar battery power supply used in navigation lights in all of China was over 7 kW.

2. Railroad Signal Lights

China's railroads have over 5,000 stations. Of this number over 1,500 stations do not have ac power supply or have unreliable ac power supply. By the end of 1983, nation-wide, 15 railroad bureaus had installed, at over 120 railroad stations, 280 silicon solar battery powered railroad signal lights. The overall power is over 8 kW.

3. Electric Fences

Electric fences powered by solar batteries to prevent loss of grassland is an ideal application. China has 3.3 billion mu of grazable grassland. Electric fences began to be used in 1979 and by the end of 1983, over 140 farms nation-wide were using electric fences. The overall battery power is 3kW.

4. Black Lights

By the end of 1983, there were over 200 applications nation-wide, with an overall battery power of 4 kW.

5. Battery Charging Power Supplies

By the end of 1983, the overall solar battery power of small battery chargers was 1 kW, the overall power used for television relay power supplies was 1.5 kW, the overall power used for yurt illumination was 8-9 kW. The Fukang Xian Solar Battery Charging Station currently under construction in Xinjiang Autonomous Region will have a maximum capacity of 5 kW.

6. Military Communications and Illumination

Maximum capacity of 3 kW.

Other applications of solar batteries include solar-powered rubber tapping lights, solar powered surgical lights, meteorological stations, rural carrier telephone power supply, oil pipeline and reservoir sluice gate cathode protection, forest fire monitor power supply, and irrigation pumps. In addition, the joint Chinese-West German 10-kW photoelectric station in Daxing Xian, Beijing Municipality, is used for photoelectric water pump water supply. The joint Chinese-Japanese 10-kW photoelectric station built in Lanzhou is used for illumination in rural homes.

C. Generating Electricity With Solar Heat

In the past few years, China has carried out some small-scale exploration in using solar heat to generate electricity. The Shanghai College of Machinery test-developed a facility for generating 1 kW of electricity by low temperature solar heat. Tianjin University built a tower-type solar-powered test power station designed with an output power of 1 kW.

The Xiangtan Electrical Machinery Plant is now developing with the U.S. Space Electronics Company a 5-kW focused solar-heat generating facility. The first model was put into trial operation in October 1984, but for a variety of reasons, it only generated 2 kW and did not reach the design standard. It is predicted that this facility is scheduled to be purchased by the UN at $50,000 per unit. After being developed, the Xiangdan Electrical Machinery Plant may produce 100 units per month. The second phase of cooperation in this project will change the present high-speed steam turbine generator to Sterling generators to improve the performance of the facility.

In view of the present situation, China's research on using solar heat to generate electricity is basically at a standstill.

8226
CSO: 4013/104

SUPPLEMENTAL SOURCES

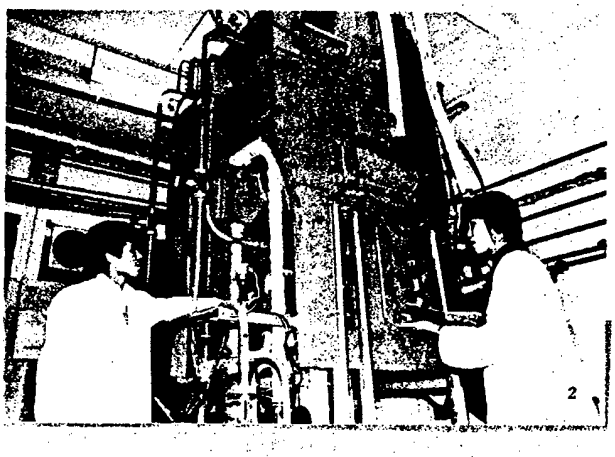
ENERGY INSTITUTE EXPLORES ALTERNATIVE ENERGY SOURCES

Beijing KEXUE SHIYAN [SCIENTIFIC EXPERIMENT] in Chinese No 3, 10 Mar 86, inside back cover

[Text] The Guangzhou Energy Institute of the Chinese Academy of Sciences undertakes research on new energy sources such as biomass, solar energy, geothermal energy, and ocean energy, as well as conventional energy conservation technology. The Energy Institute has 196 personnel, including 144 scientists and technicians. Since its establishment, the institute has made achievements in 23 areas of research and has won two National Science Conference awards. The Guangzhou Energy Institute, in order to resolve the energy problem that confronts the nation's economic growth, adheres to the scientific research policies that serve the national economy.

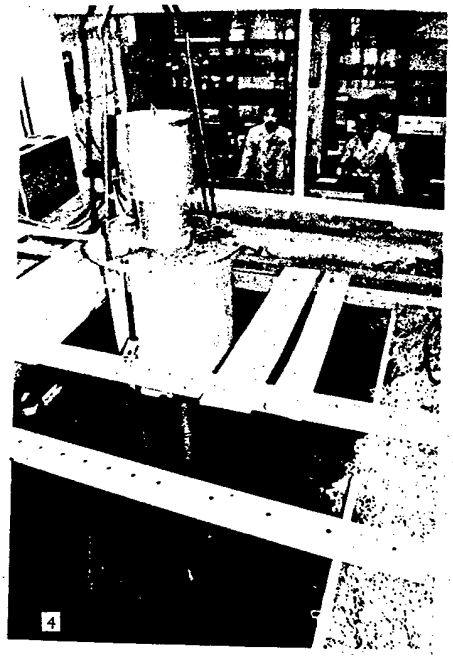
At left, Senior Engineer Huang Zhicheng of the institute "debugs" a solar heat collector. Expanding research on the application of solar heat has produced dryers, seawater desalinization units, refrigeration (air conditioning) equipment, and hot water heaters.

At right, an experimental facility that uses hot water as a heat source developed by the institute. It makes use of industrial waste water to produce the coolant needed for air conditioning.



Shown at left are research personnel experimenting with a heat pump to heat the water of a swimming pool. The installation, maintenance, and use of the heat pump are simple and it can save 70 percent of the electrical energy needed.

Shown at right are research personnel using a simulator to produce "waves" that would generate electricity. In this area of ocean wave energy research, the institute has developed China's first successful 10-watt navigation buoy.



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CSO: 4013/116

SUPPLEMENTAL SOURCES

BRIEFS

JIANGXIA STATION COMPLETED--Beijing, 17 Mar (XINHUA)--China's largest tidal power station has been completed in Jiangxi Harbor in Zhejiang's Wenling County. The station, named "Jiangxia Tidal Experimental Power Station," has an installed capacity of 3,200 kilowatts and is capable of generating 10 million kWh of electricity a year. It is the third largest tidal power station in the world. [Summary] [Beijing XINHUA Domestic Service in Chinese 1452 GMT 17 Mar 86 OW]

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CSO: 4013/108

CONSERVATION

BRIEFS

6TH FYP CONSERVATION FIGURES--The State Planning Commission recently revealed that during the Sixth 5-Year Plan, the dual policy of energy development and energy conservation was completely successful, and the amount of energy conserved and saved was equal to 120 million tons of standard coal. Energy conservation accounted for half of the energy resources needed for the 10 percent average annual growth in the national economy. During the Sixth 5-Year Plan, every region, department and enterprise raised the management level of energy conservation work by establishing laws and regulations to strengthen basic work. We transformed equipment that consumed a large amount of energy, and we developed and popularized new energy-saving technology, techniques and new materials. In 5 years, we transformed more than 2,000 industrial kilns and furnaces, and recovered more than 4 million standard tons of coal in thermal resources. We added two thermal generators with an installed capacity of 600 MW, and we developed and popularized more than 1,000 varieties of wind generators and water pumps with a 1970's international technology level. By strengthening management and technology measures, the level of energy consumption of two-thirds of major energy-consuming products decreased. For example, the amount of coal required for steel smelting decreased 14.2 percent. Most rural areas increased the use of energy-efficient coal stoves, methane, etc., to conserve firewood. During the Sixth 5-Year Plan, the amount of energy conserved and developed in rural areas was equal to more than 20 million tons of standard coal. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 4 Apr 86 p 3] /12232

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